VERBAL BEHAVIOUR CHANGE IN LONG-STAY PSYCHIATRIC PATIENTS AS A FUNCTION OF RATIO SCHEDULES OF TOKEN REINFORCEMENT

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by
William Alexander Murray Black
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ABSTRACT

The effect of token reinforcement on the verbal participation of long-stay male psychiatric patients in a social activity was studied in four experiments. In Experiment I the characteristic effects of continuous reinforcement were found with 21 of the 37 patients on the ward. In Experiment II an effective and quick way of establishing tokens as conditioned reinforcers was demonstrated with 25 patients. In Experiment III the 37 patients were divided into four groups, with high responders, low responders and non-responders equally distributed in each, to determine the effect of fixed ratio schedules of token reinforcement on verbal participation. In Experiment IV the effect of different schedules of variable ratio token reinforcement on the same group of patients is examined.

To introduce the studies a brief but comprehensive survey of token systems in applied settings is made. The term 'token economy' is defined and distinguished from 'token reinforcement system'. Studies of non-verbal behaviours using intermittent token reinforcement are reviewed. This is followed by a review of studies of verbal behaviour in which token reinforcement has been variously delivered on continuous, fixed interval, variable interval, fixed ratio and variable ratio schedules. Finally a general survey of the operant conditioning of verbal behaviour is made and a comprehensive bibliography of studies with token systems until December 1975, is provided.

To Shirley

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CHAPTER 1

INTRODUCTION

A Case History with Acknowledgements

The birth of the goddess Athene was dramatic: she sprang fully armed out of the head of Zeus after his skull had been obligingly split by a junior colleague. Scientific research often seems to be similar in its origin but this is misleading as the work of Watson and Crick on DNA demonstrates (Watson, 1968). Medawar (1969) makes much the same point in discussing the question of scientific induction and Skinner (1956) underlines the fact that in scientific practice advances depend to some extent on serendipity. Therefore, it is perhaps not out of place to provide a case history of a brainchild which developed over a number of years and which received support from a number of people.

This thesis had its beginnings in 1970 with a reading of The Token Economy by Ayllon and Azrin (1968); the book fired my interest in applied behaviour analysis and served as an introduction to the use of token reinforcement procedures. It also raised the query of why schedules other than those of continuous reinforcement were ineffective in a practical setting. Ayllon and Azrin say "Although much is known about schedules of intermittent reinforcement, most of this information appeared to be irrelevant to the practical objective of providing maximum motivation, since non-intermittent reinforcement was found in practice to be most effective." (p.17, 1968) This discrepancy with the findings of laboratory research is puzzling, especially as the authors cite no evidence to support their statement.

In 1971 with my appointment to a part-time position in a mental hospital together with a full-time academic position it was possible to begin an investigation. The first step was to become involved in a male long-stay ward at Sunnyside Hospital, Christchurch, with patients most of whom had the diagnosis of chronic schizophrenia. This step had the positive support of the Medical Superintendent, Dr Edwin Hall, whose continuing encouragement has been most helpful.

In 1971 also, the ward was visited by Professor Carl Roberts, a pioneer in devising an institution-wide token economy (Roberts and Perry, 1970). He commented on the virtual absence of verbal interaction amongst the patients and suggested that it might be worthwhile to attempt to increase their verbal behaviour. But it was not until 1972 that the crucial event occurred.

At morning tea one day Ms Lynn Walton, Occupational Therapy Aide on the ward, expressed frustration at the low level of participation by the patients in the weekly quiz. This was in marked contrast to the high level of activity in their weekly session of housie (bingo) where prizes of chocolate and cigarettes could be won. It seemed possible that the difference in participation was directly related to the availability of consumable reinforcers and so a research programme was initiated. The first object was to see whether verbal participation in the weekly quiz could be increased by token reinforcement, in a way that demonstrated the control of a schedule of continuous conditioned (token) reinforcement. If this could be done

then it should be possible to examine the effects of intermittent schedules of reinforcement, specifically those of fixed ratio and variable ratio, on verbal behaviour.

Experiment I was planned and carried out in 1972. It investigates the effect of continuous token reinforcement on verbal behaviour and it would not have been possible without the assistance of several people. In particular, I wish to thank Ms Jacqueline Horn for her part in collecting the data and for writing up the study for publication (Horn and Black, 1973).

Experiment II investigates the establishment of tokens as conditioned reinforcers of verbal behaviour. It was planned and carried out in 1973. The idea for the study was provided by Mr Geoffrey Samuels. However, we both shared in its design and execution and at my suggestion he wrote it up for publication (Samuels and Black, 1974). Thanks are also due to Ms Jacqueline Horn, Mr Alan Prosser and Mr Lance Seymour for their assistance in data collection.

Experiment III investigates the effect of fixed ratio schedules of token reinforcement on verbal behaviour. It was planned and carried out also in 1973. In this study Mrs Marie Ballagh shared in the design and execution and she has written a separate account (Ballagh, 1973). Thanks are also due to Mr Alan Prosser, Mr Lance Seymour, Mr Robb Stanley, Ms Sandra Stewart and Ms Ione Wooles for their assistance in the data collection.

Experiment IV investigates the effect of variable ratio schedules of token reinforcement on verbal behaviour. It was planned and carried out in 1973-74. It is the major experiment and the responsibility for the design is mine. The study could not have been carried out, however, without the active and continuous participation of Mr Alan Prosser and, with permission, he included an analysis of the data with some work of his own (Prosser, 1974). Mr Lance Seymour is also thanked for his assistance in the collection of data.

Thanks are also due to Mr Newton and Mr Dodd of the Sunnyside Hospital nursing staff for their useful advice on how to deal with some of the practicalities an investigator has to overcome when carrying out research in a 'natural' setting.

A debt of gratitude is owed to Bunting and Co. for providing the sheets of polystyrene from which the tokens were made and Mr John Barton and Mr Laurie Foulds are thanked for making the tokens.

Mrs Joyce Read, Senior Occupational Therapist, is thanked for encouraging the participation of Miss Walton of her Department in the first experiment and for procuring the material for the tokens and seeing that they were suitably finished. Thanks are also due to the women patients who carried out this task.

Special thanks are due to Ms Lynn Walton for conducting the quiz sessions in Experiment I and for tolerating the aversiveness of the four week period of extinction which she found distressing. Without her this study would not have begun.

Mr Jim Pollard is thanked for his most helpful supervision of this thesis. Dr Hugh Priest is thanked for assisting with statistical advice; and the constructive comments of Mr Neville Blampied have been both welcome and helpful.

Mr John Hannah and Mr Winton Bell are thanked for drawing the figures for this thesis and the studies published from it and Mr Howard Patterson is also thanked for technical assistance.

Mrs Willy Van der Goot and Ms Julie Harrington kindly assisted in the preparation of the manuscript and a major acknowledgement is due to my wife who typed the final manuscript.

Thanks are due to Professor Crowther, Head of the Department of Psychology and Sociology for the purchase of backup reinforcers (chocolate and cigarettes), and to Mr Proctor, Hospital Secretary, Sunnyside Hospital, for authorising the payment of money for additional comforts for the ward's patients to maintain the therapeutic gains achieved.

Finally my thanks to the patients in B Ward who were the subjects in the studies which follow. The ethics of involving them must be considered. That they benefited is suggested by such comments as "I like it when you come on to the ward Mr Black" and "Well, we've had a good innings" when one study ended. Participation in the studies was voluntary and the patients benefited materially (in terms of cigarettes and chocolate) and behaviourally (in terms of greater verbal participation in a social activity); and they were deprived in no way if they did not take part.

CHAPTER 2

TOKEN SYSTEMS: A REVIEW OF THE LITERATURE

2.1. The Token Economy: Historical Developments

Alexander Maconochie was probably the first person to implement a token economy, as Eysenck (1972) points out. It was in a penal settlement on Norfolk Island during the 1840s and his biography has been written by Barry (1958). Maconochie's use of conditioned positive reinforcement was so effective that he was dismissed from his position; his procedures were contrary to the philosophy that only punishment was effective in changing the behaviour of felons. He was aware of the power of operant conditioning without, of course, the knowledge of operant terminology or the finer aspects of methodology. His work underlines the importance of Skinner's discoveries for, despite what his critics might think, Skinner discovered and defined the principles of operant psychology, he did not invent them.

Within the framework of operant psychology Ayllon and Azrin (1965, 1968b) were the first to establish a token economy: the programme was initiated in November 1961. It is now well known that this was in a closed female back ward for psychotics which was set up as an experimental ward at Anna State Hospital, Illinois. They were not, however, the first investigators to use tokens as conditioned reinforcers, as work with animals was reported nearly thirty years earlier (e.g. Cowles, 1937; Cowles and Niessen, 1937; Wolfe, 1936) and later by Kelleher (1957).

Also they were not the first to apply operant principles to assist the severely debilitated. Fuller (1949) undertook a pioneering study with a vegetative patient and later Lindsley (1956) reported the use of operant conditioning methods in research with chronic schizophrenics. His investigations were in a laboratory setting whereas those of Ayllon and Azrin were carried out on a hospital ward. The feasability of undertaking such a project was supported by their other work with psychotics e.g. Ayllon and Haughton (1962); Ayllon and Michael (1959); Hutchinson and Azrin (1961); and by the work of other investigators which they cite.

In their first report on the token economy they write, (Ayllon and Azrin, 1965, p.382):

> There is growing evidence of the general applicability of this social reinforcement program. It has been adopted with almost no change by Spradlin (personal communication) ... with mentally retarded children. Similarly, by L. Krasner (personal communication) ... with male adult psychotics and ... by H. Cohen (personal communication) for use with juvenile delinquents at the National Training School for boys.

Spradlin and his colleagues have published studies of mental retardates e.g. Evans and Spradlin (1966); Girardeau and Spradlin (1964); Lent (1968); Lent, Leblanc and Spradlin (1970); Spradlin and Girardeau (1966); including a functional analysis of speech and language behaviour (Girardeau and Spradlin, 1970), and reports of the effects of different schedules of reinforcement on

severely retarded subjects, (Spradlin, 1962; Spradlin, Girardeau and Corte, 1965).

Other token economy studies with mental retardates have bee reported by Ball (1969); Bath (1974); Bourgeois (1968); Bucher and Hawkins (1973); Fielding (1972); Musick and Luckey (1970); Roberts and Perry (1970).

Krasner and Atthowe started a token economy for chronic psychotics at the Veterans Administration Hospital at Palo Alto, California, in September 1964 (Krasner 1968). Separately, together, and with others they have produced experimental studies, wards manuals for both staff and patients, informal papers, reviews in journals and books and a bibliography, e.g. Atthowe (1964a); Atthowe (1964b); Atthowe (1966); Atthowe (1969); Atthowe (1971); Atthowe (1973); Atthowe and Krasner (1965); Atthowe and Krasner (1968); Krasner (1968); Krasner (1970a); Krasner (1970b); Krasner (1971); Krasner and Atthowe (1971); Krasner, Atthowe and Silva (1969); Krasner and Krasner (1973); Krasner and Ullmann (1973); Ullmann and Krasner (1969); Ullmann and Krasner (1975).

A token economy for chronic psychotics was also started by Schaefer and his associates at Patton State Hospital, California, in September 1964 (Schaefer, 1966). Schaefer (1966) and Schaefer and Martin (1966) were the first to publish readmission figures after discharge from a token economy and to show that these were better than would be

predicted from hospital re-admission data. Also, they were the first to use a control group in a token economy to which patients were randomly assigned. They have also provided a detailed account of the setting up and maintenance of a token economy (Schaefer and Martin, 1969; 1975).

Other reports on the Patton State Hospital programme have been written by Bruce (1966) and Gericke (1965). It is also discussed by Liberman (1968) and featured in the film Reinforcement Therapy made in 1966 by Smith, Kline and French Laboratories, Philadelphia and there is further informal material in the Supplement which accompanies the film. One of the unexpected consequences of the programme, however, was the questionable work of Cotter in South Vietnam (Cotter, 1967; 1969). He attributes his operant conditioning programme, with the establishment of a 'token economy' in a mental hospital during his two months' stay, to the inspiration he received from the Patton State programme and from watching the work of Lovaas.

The Patton State programme has also not been without its critics: Berwick and Morris (1974, p.435) say, ...

> some investigators may have been overzealous. For example, at Patton State Hospital in California, a program was instigated for some patients in which food was used as a reinforcer and tokens were required in order to obtain meals (Schaefer, 1966). In this program the hospital was willing to allow a patient to go for as long as five days without food or until he was at 80% of his normal body weight. Wexler (1973) indicated

> that practices such as this raise many legal issues pertaining to the patient's rights to noncontingent food and personal safeguards.

An important ethical issue has been raised here but it is only fair to point out that Schaefer has been misrepresented. This is shown by quoting verbatim the passage to which Berwick and Morris (1974) take exception (Schaefer, 1966, p.33):

> (1) Feeding problems.
>
> (a) Refusing to eat.
>
> This problem is dealt with by simply leaving it up to the patient whether he wants to eat or not. No patient has ever missed more than five meals. Medically, however, we would be willing to let a patient go for as long as five days without food, or until he has been reduced to 80% of his previous body weight. So far, even the most stubborn cases, however, have not even approached this limit.

This procedure was for patients <u>who refused to eat</u>, a point which Berwick and Morris (1974) fail to mention. (It is true, however, that usually patients required a token to be admitted to the dining room.)

They also make no mention of a later paper by Sobell, Schaefer, Sobell and Kremer (1970) addressed to the procedure of food priming - a therapeutic tool to increase the percentage of meals bought by chronic mental patients.

Other research on token economies with institutionalised patients has been reported by: Aitchison (1973); Arann, Esposito and Guiner (1974); Baker, Hall and Hutchinson (1974);

Birky, Chambliss and Wasden (1971); Cochran (1969); Cohen, Florin, Grusche, Meyer-Osterkamp and Sell (1972); Davis (1973); Ellsworth (1969); Fernandez, Fischer and Ryan (1973a, 1973b); Foster (1969) cited by Liberman (1971); Garlington and Lloyd (1966); Gripp and Magaro (1971); Gripp and Magaro (1974); Grossman and Kilian (1974); Heap, Boblitt, Moore and Hord (1970) and criticised by Hersen and Eisler (1971); Hersen, Eisler, Smith and Agras (1972); Liebson, Cohen, Faillace and Ward (1971); Lloyd and Abel (1970); Lloyd and Garlington (1968); Mumford, Patch, Andrews and Wyner (1975); Marks, Schalock and Sonoda (1967); Marks, Sonoda, Collins, Schalock, Tibbets and Kreie (1968); Narrol (1967); Rybolt (1975); Shean and Zeidberg (1971); Steffy, Hart, Craw, Torney and Marlatt (1969); Ulmer (1970); Winkler (1969); Winkler (1970).

Research on token economies in a community-based setting has been reported by Henderson and his colleagues: Henderson (1969); Henderson (1971); Henderson and Scoles (1970); Hibbert and Henderson (1971); Kelly and Henderson (1971); Samuels and Henderson (1971);

Also work with psychotics in hospital and community settings has been carried out by Fairweather and colleagues (Fairweather, 1964; Fairweather, 1967; Fairweather, Sanders, Maynard and Cressler, 1969). This is seen by these investigators as applied social psychology

rather than applied operant psychology, but in fact they use money rather than plastic tokens as conditioned reinforcers to effect the same ends.

Offenders - young, old, retarded, insane, and military - have had their behaviour modified in token economies. Ayllon and Azrin (1965 p.382) mentioned Cohen, who has since published, Cohen (1968); Cohen and Filipczak (1971a); Cohen and Filipczak (1971b); Cohen, Filipczak and Bis (1970). Other reports of the use of token economies with offenders have been published by: Burchard (1967); Burchard (1969); Lachenmeyer (1969) with antisocial retardates; Fixsen, Phillips and Wolf (1973); Karacki and Levinson (1970); Liberman, Ferris, Salgado and Salgado (1975); Phillips (1968); Phillips, Phillips, Fixsen and Wolf (1971); Rose, Sundel, Delange, Corwin and Polumbo (1970) with delinquent and 'pre-delinquent' boys; Boren and Colman (1970); Colman (1971); Colman and Baker (1969); Colman and Boren (1969); Ellsworth and Colman (1969) with delinquent soldiers; Lawson, Greene, Richardson, McClure and Padina (1971) with maximum security correctional patients; and McKee (1974) with adult prisoners.

Ayllon and Azrin, since the publication of The Token Economy in 1968 have changed the focus of their interests. Azrin appears to have published no further

research with tokens and Ayllon is studying the application of token reinforcement in education e.g. Ayllon, Garber and Pisor (1975); Ayllon, Laman and Burke (1972); Ayllon and Roberts (1974). Regrettably, the review article, "The Token Economy: Now", by Ayllon and Roberts (1972) is insubstantial. But other reviews and surveys differing in scope and intention are available:

> Carlson, Hersen and Eisler (1972); Chase (1970); Cochran (1960); Davison (1969); Hall (1973); Kazdin (1972a); Kazdin (1975); Kazdin and Bootzin (1972); Kazdin and Bootzin (1973); Krasner (1968); Krasner (1970a); Krasner (1970b); Krasner (1971); Krasner and Atthowe (1971); Krasner, Atthowe and Silva (1969); Krasner and Krasner (1973); Liberman (1968); Liberman (1971); Paul (1969); Silva (1969); Strenger and Peck (1970).

2.2. Token Economy: A Definition

Although they coined the name 'The Token Economy' in the title of their book, Ayllon and Azrin (1968b) do not define what a'token economy' is. But subsequently Ayllon and Roberts (1972, p.83) do...

> The token economy is the determination of target behaviors that are directly measurable, have functional characteristics, and have relevance for the individual not only in the treatment environment but also in outside, normal, or posttraining environments. It is the specification of a certain time and place in which the target

> behavior will be followed by certain conditioned reinforcers (tokens, points). It is the availability of a wide range of "back-up" reinforcers (consumables, cosmetics, activities, priorities). It is a system of exchange in which the ratio of conditioned reinforcers to "back-up"reinforcers is based on the behavior of the individual. It is the continuous analysis of the relationship between behavioral requirements and their consequences, and adjustments based on this analysis. It is a continuous self-corrective procedure that enables the therapist to abandon any misconceptions about the presumed effectiveness of the ongoing therapeutic procedures. It is a system that protects the individual from capriciousness on the part of those whose job is to care for, train, or teach him. It is a system that recognizes the individuality of those involved, designed to strengthen behaviors useful to the individual, not merely those that will benefit the staff or the therapist.

They say

1. It is not the distribution of tokens. "The mere use of tokens or other such conditioned reinforcers by no means defines the term."
2. It is not a closed economic system.
3. It is not an inflexible system. It cannot be "set up" a priori.
4. It is not designed to facilitate passive participation.
5. It is not independent of the individual's needs.

It has, however, been possible to study economic theories and practices within a token economy, e.g., Battalio, Kagel, Winkler, Fisher, Miles, Basmann and Krasner (1973); Fethke (1972); Fethke (1973); Winkler (1969); Winkler (1971b); Winkler (1972); Winkler (1973a); Winkler (1973b).

TABLE 1

Token Economy: Miscellaneous Studies and Reports*

Aitchison and Green (1974)

Allen and Magaro (1971)

Anker (1961)

Aveni (1974)

Bornstein, Bugge and Davol (1975)

Coe (1974)

Daly (1974)

Deering (1973)

Fisher (1973)

Fritzhand (1975)

Fingelton and McCutcheon (1969)

Gates (1972)

Glickman (1974)

Golub, C. (1969)

Golub, H. (1969)

Hall and Baker (1973)

Hayden, Osborne, Hall and Hall (1974)

Horsley (1971)

Hughes (1973)

Kazdin (1972b)

Kazdin (1973c)

Kinkade (1973)

Lehrer, Schiff and Kris (1970)

Logan (1970)

Liebson, Cohen and Faillace (1972)

Lindberg (1973)

McQueen (1973)

McReynolds and Coleman (1972)

Maley (1974)

Maley, Feldman and Ruskin (1973)

Mann and Moss (1973)

Marr, Lilliston and Zelhart (1974)

Milby, Pendergrass and Clarke (1975)

Miller (1973)

Nevin (1970)

*Not included are a) studies of verbal behaviour
b) studies using intermittent reinforcement
c) studies already cited in this Chapter
d) token systems in education.

Table 1 : Token Economy: Miscellaneous Studies and Reports, continued.

Peck and Thorpe (1972)

Rioch (1971)

Skinner (1948)

Suchotliff, Greaves, Stecker and Berke (1970)

Tanner, Parrino and Daniels (1975)

Trudel, Boisvert, Maruca and Leroux (1974)

Ulmer (1971)

Van Allen (1973)

Vitulli (1973)

Volpe and Kastenbaum (1967)

Wolff and Vrazel (1969)

Miscellaneous studies of token ec onomies are shown in Table 1. This provides an extensive list of the studies up to December, 1975, except that studies of verbal behaviour and studies using intermittent reinforcement are omitted as they are considered in more detail in sections 2.6 and 2.8. Also excluded are studies already mentioned in this Chapter and studies in the field of education which are shown in Table 3.

2.3 Token Reinforcement Systems

A distinction should be made between the terms 'token economy' and 'token reinforcement system', for as Ayllon and Roberts (1972 p.83) say of 'token economy': "The mere use of tokens or other such conditioned reinforcers by no means defines the term". It is therefore regrettable that two major reviews of the token economy literature by Kazdin and Bootzin (1972, 1973) not only fail to make this distinction but the authors also fail to state what they understand the term 'token economy' to mean; and the same is true of Kazdin's (1975) review.

'Token reinforcement system' is a better term to describe the use of tokens as conditioned reinforcers in the modification of the behaviour of individuals without including all the features of a token economy outlined by Ayllon and Roberts. A good example of a token reinforcement system is that described by Stuart (1969a; 1969b) with regard to marital therapy and miscellaneous studies using token reinforcement are shown in Table 2. This

provides an extensive list of studies up to December 1975 except that studies dealing with intermittent token reinforcement and the token reinforcement of verbal behaviour are omitted as they are considered in more detail below in sections 2.6 and 2.8 respectively.

TABLE 2

Token Reinforcement: Miscellaneous Studies*

Abrams, Hines, Pollack, Ross, Stubbs and Polyot (1974)

Andrews (1971)

Ayllon, Simon and Wildman (1975)

Balcerzak and Siddall (1974)

Berstein (1972)

Bricker, Morgan and Grabowski (1969)

Burchard and Tyler (1965)

Christopherson, Arnold, Hill and Quilitch (1972)

Conrad (1974)

Craddick (1972)

Crowley (1975)

Everett, Hayward and Meyers (1974)

Frankel (1973)

Fry and Barrer (1974)

Goldberg, Katz and Yekvtiel (1973)

Goodwin and Mahoney (1975)

Harmatz and Lapuc (1968)

Haughton and Ayllon (1965)

Hersen, Eisler, Alford and Agras (1973)

Hingten and Trost (1966)

Horner and Keilitz (1975)

Hunt and Zimmerman (1969)

Lentz (1975)

Logan, Kinsinger, Shelton and Brown (1971)

McAllister (1970)

McConahey (1971)

MacVaugh (1970)

Milby, Willcutt, Hawk, MacDonald and Whitfield (1972)

Moser (1974)

O'Leary, Poulos and Devine (1972)

Osborne (1969)

Parrino, George and Daniels (1971)

Presland (1974)

*Not included are a) studies of verbal behaviour
b) studies using intermittent reinforcement
c) token systems in education

Table 2: Token Reinforcement: Miscellaneous Studies, continued.

Quilitch (1974)

Ribes-Inesta, Duran, Evans, Felix, Rivers & Sanchez (1973)

Rickard & Saunders (1971)

Rosenbaum, O'Leary & Jacob (1975)

Sachs (1975)

Schwitzgebel (1969)

Shealy (1970)

Slavin & Daniels (1971)

Smith (1971)

Stuart (1969a)

Stuart (1969b)

Tenbrunsel, Lottman, Coby & Oziel (1971)

Thorpe (1962)

Upper & Goodenough (1971)

Upper & Newton (1971)

Watson, Orser & Sanders (1968)

Williams, Martin, McDonald, Hardy & Lambert (1975)

Wooley & Blackwell (1975)

Wehman (1974)

Weisberg, Lieberman & Winter (1970)

Welsh & Alvord (1973)

Wexler (1973)

Wolff & Gray (1973)

Zimberoff (1972)

Zimmerman, Studkey, Garlick & Miller (1969)

2.4 Token Systems in Education

The distinction between the terms 'token economy' and 'token reinforcement system' as outlined above is difficult to maintain in considering studies carried out in the field of education for when the topic of token economies in the classroom is discussed it is not always clear what some writers have in mind, e.g., Skinner (1973). The less precise term 'token systems' used by Ayllon, amongst others, (e.g., Ayllon, Garber and Pisor, 1975), blurs the distinction and enables the whole field to be considered under one heading.

Research on token systems in education has expanded rapidly as can be seen by the dates of the studies listed in Table 3, which provides a comprehensive coverage of studies up to December 1975. Not included, however, are studies which have used intermittent schedules of reinforcement, or studies of verbal behaviour in which tokens have been used. These studies are considered in more detail in sections 2.6 and 2.8. Reviews of token systems in education are provided by Altman and Linton (1971); Axelrod (1971); Krasner and Krasner (1973); O'Leary and Drabman (1971).

TABLE 3

Token Systems in Education*

Altman and Linton (1971)

Axelrod (1971)

Ayllon, Garber and Pisor (1975)

Ayllon, Laman and Burke (1972)

Ayllon and Roberts (1974)

Bailey, Wolf and Phillips (1970)

Baker, Stanisk and Fraser (1972)

Ballard & Glynn (1975)

Bassett, Blanchard and Koshland (1975)

Bijou, Birnbrauer, Kidder and Tague (1966)

Birnbrauer and Lawler (1964)

Birnbrauer, Wolf, Kidder and Tague (1965)

Bonanno (1974)

Brearley (1970)

Breyer & Allen (1975)

Buckholdt and Ferritor (1974)

Bushell, Wrobel and Michaelis (1968)

Cantrell, Cantrell, Huddleston and Wooldridge (1969)

Clark, Lachowicz and Wolf (1968)

Clement and Milne (1967)

Clements and McKee (1968)

Cotler, Applegate, King and Kristal (1972)

Craig and Holland (1970)

Daniels (1973)

Drabman (1972)

Drabman, Spitalnik and Spitalnik (1974)

Drabman and Tucker (1974)

Dyer (1968)

Ellery, Blampied and Black (1975)

Flowers (1974)

Feingold and Mahoney (1975)

Frederikson and Frederikson (1975)

Fjellstedt and Sulzer-Arázoff (1973)

Fry (1973)

Glynn (1970)

Glynn (1972)

Glynn and Thomas (1974)

Graubard (1969)

Greenwood, Sloane and Baskin (1974)

Gregory (1973)

*Not included are a) studies of verbal behaviour
b) studies of intermittent reinforcement

Table 3: Token Systems in Education, continued.

Haring, Hayden and Nolen (1969)

Henson (1975)

Herman and Tramontana (1971)

Hewett, Taylor and Artuso (1969)

Hislop, Moore and Stanish (1973)

Iwata and Bailey (1974)

Jenkins and Gorraafa (1972)

Kazdin (1971c)

Kazdin (1973e)

Klein (1975)

Knapczyk and Liningston (1973)

Knight, Hasazi and McNeil (1971)

Krasner and Krasner (1973)

Kuypers, Becker and O'Leary (1968)

Lovitt and Curtiss (1969)

Levine and Fashacht (1974)

McClure (1974)

McKenzie, Clark, Wolf, Kothera and Benson (1968)

McLaughlin and Macaby (1972)

McNamara (1971)

Maguire (1974)

Mandelker, Brigham and Bushell (1970)

Marsh (1975)

Miller and Schneider (1970)

Mulligan, Kaplan and Reppucci (1973)

O'Leary and Becker (1967)

O'Leary, Becker, Evans and Saudargas (1969)

O'Leary and Drabman (1971)

O'Leary, Drabman and Kass (1973)

O'Leary and O'Leary (1972)

Packard (1970)

Perline and Levinsky (1968)

Quay, Sprague, Werry and McQueen (1967)

Quay, Werry, McQueen and Sprague (1966)

Ramp (1973)

Rickard, Melvin, Creel and Creel (1973)

Santogrossi, O'Leary, Romanczyk and Kaufman (1973)

Schmidt and Ulrich (1969)

Schwarz and Hawkins (1970)

Skinner (1974)

Staats and Butterfield (1965)

Table 3: Token Systems in Education, continued.

Staats, Minke and Butts (1970)

Staats, Minke, Finley, Wolf and Brooks (1964)

Staats, Staats, Schultz and Wolf (1962)

Stedman, Peterson and Cardarelle (1971)

Tyler (1967)

Tyler and Brown (1968)

Walker and Buckley (1968)

Walker, Hops and Fiegenbaum (in press)

Willis (1971)

Wolf, Giles and Hall (1968)

Zimmerman, Zimmerman and Russell (1969)

2.5 Summary

A brief but comprehensive survey of token systems in applied settings is made:

The historical development of the 'token economy' is traced and a survey of studies with chronic psychotic patients, mental retardates, community-based programmes, and offenders is given (2.1).

The term 'token economy' is defined and distinguished from 'token reinforcement system' (2.2). A survey of miscellaneous studies and reports of token reinforcement systems is made (2.3), and evidence is given of the rapid growth of research with token systems in education (2.4).

Not included in the survey are studies which have used intermittent schedules of token reinforcement (see section 2.6) or studies of verbal behaviour in which tokens have been used (see section 2.8).

2.6 Intermittent Schedules of Token Reinforcement

The majority of the studies investigating the effects of token reinforcement on human behaviour in applied settings have used schedules of continuous reinforcement: there are, however, a number of studies in which intermittent schedules of token reinforcement have been used. These are based on the demonstrated effectiveness of intermittent reinforcement in maintaining behaviour and in providing resistance to extinction in studies where tokens have not been used and this work in the main has been carried out with animals. It has been well reviewed elsewhere, e.g., Jenkins and Stanley (1950) and Lewis (1960), and in their review of positive conditioned reinforcement Kelleher and Gollub (1962) include a discussion of intermittent schedules of token reinforcement based on work with animals. As regards humans, few studies have systematically examined the relative effectiveness of changes in the scheduling of intermittent token reinforcement.

Studies that have used intermittent schedules of token reinforcement in applied settings with non-verbal behaviour are outlined in Table 4 and summarised in section 2.7. (Studies of verbal behaviour are reviewed in section 2.8). Three further studies, by Gericke (1965), Hewett (1967) and Schaefer and Martin (1966), are not included in Table 4 as no specific data are reported about the intermittent schedules of reinforcement used. A pertinent comment by Kazdin and Bootzin (1972, p.21) still applies: "So little is known about the effects of schedules of reinforcement in token economies, that it is an obvious next step for research in the area."

Intermittent Token Reinforcement of Non-Verbal Behaviour

Authors	Subjects	Schedule Type	Target Behaviour	Outcome
Bailey, Wolf & Phillips (1970)	Pre-delinquent youth (N=1)	FI (Expt. III)	Study behaviour	Resisted extinction
Baron, Kaufman & Stauber (1969)	Female college students (N= 18)	FI	Button pressing	Instruction effects more precise than reinforcement
Broden, Hall, Dunlap & Clark (1970)	7th & 8th grade special class students (N=13)	VI CRF	Study behaviour	Improvement with social reinforcement. Increase with tokens.
Evans & Spradlin (1966)	Mildly retarded males (N=12)	FR & NCR	Knob pulling task	10% higher responding under FR than NCR. But verbal instructions more potent.
Ferster & De Myer (1961)	Autistic children (N=2)	FR & VI	Appropriate behaviour	Behaviour under control of conditioned reinforcers.
Ferster & De Myer (1962	Autistic children (N=3)	FR	Key pressing "Matching to sample"	Behaviour under control of conditioned reinforcer.
Frazier (1973)	Female adults (N=15)	FR	Lever pulling	Instructions amplify effects of delayed reinforcement
Haring & Hauck (1969)	3rd, 4th, & 5th grade elementary schoolboys (N=4)	VR & CRF	Reading skills	Improved performance with feedback alone. VR not more effective than CRF

Table 4

Table 4, continued

Authors	Subjects	Schedule Type	Target Behaviour	Outcome
Haughton & Ayllon (1965)	Female Schizophrenic (N=1)	VI	Broom holding	Response maintained then extinguished.
Hingten, Sanders & De Myer (1965)	Childhood schizophrenics (N=6)	FR	Co-operative behaviour with lever	Non target social interaction increased as well as target behaviour
Hunt, Fitzhugh & Fitzhugh (1968)	Mentally retarded men (N=12)	CRF & VI	Personal appearance behaviours	Appearance best under VI. Deteriorated in extinction. Much individual variation.
Jones & Kazdin (1975)	Educable retarded children (N=4)	VI in multiple baseline	Appropriate classroom behaviour	Maintenance on follow-up but after teacher & peer praise & group contingencies
Libb, Sachs & Boyd (1973)	Academic underachieving boys (N=6)	VI FR	Non-disruptive behaviour. Academic behaviour	Behaviours controlled. Suggestion that behaviour problems controlled more efficiently with reinforcement of academic behaviours which are incompatible. FR followed VI
Liebson, Cohen, Faillace & Ward (1971)	Chronic alcoholics (N=9)	FR	Drinking behaviour	Drinking behaviour brought under operant control.

Table 4, continued

Authors	Subject	Schedule Type	Target Behaviour	Outcome
Long, Hammack, May & Campbell (1958)	4 to 8 year olds (N= c.200)	FR, FI, VI	Key pressing	Performance on FR, FI & VI Schedules similar to that for infrahuman subjects.
Meichenbaum, Bowers & Ross (1968)	Female adolescent offenders (N=10)	FI, VI	Classroom behaviours	Improved behaviour comparable to normal groups. Behaviour contrast effect.
O'Brien (1972)	Chronic alcoholic (N=1)	FR, FI	Motor task with photoelectric beam	FR:no post-reinforcement pause;FI: No scalloping Otherwise response behaviour similar to infrahuman subjects. (Alcohol as back-up reinforcer)
Phillips, Phillips, Fixsen & Wolf (1971)	"Pre-delinquent" boys (N=4)	VI (Expt.II)	Room cleaning	Behaviour maintained even on 8% reinforcement.
	(N=5)	FI (Expt.III)	Money saving	"Scallop" effect observed.
Schroeder (1972)	Adult retardates I (N=6)	FI, FR	Work rates	Work rates positively related to FI but inversely related to FR schedules
	II (N=1)	FR	Response force	When response force requirement high a small FR of reinforcement maintains output better than large rate.

Table 4, continued

Authors	Subjects	Schedule Type	Target Behaviour	Outcome
Schroeder (1972)	Adult retardates III (N=4)	FI, VI, FR, VR	Work rates	Large decrease in work with increase in reinforcement regardless of schedule type.
Slemon (1971)	Mentally retarded children (N=24)	VR	Lever pulling	"Overconforming" children responded at higher rate than underconformers.
Smith & Carlin (1972)	Psychotic female (N=1)	FI	Hysterical tantrums Abnormal gait	Cessation of outbursts Gait normal.
Wegman (1974)	"Normal" 2nd grade children (N= 39)	FI, VI	Social & educational behaviours	Expected improvement occurred. Effect of the FI & VI schedules not significantly different.
Weiner (1972)	Females (2) Males (3) (N=5)	FR	Button pressing	Higher response rates for tokens (points) plus money back-up than either tokens without money back-up or tokens plus non contingent money even when this worth more.
Winkler (1969)	Female chronic psychiatric patients (N=58 to 65)	CRF VR	Self care behaviours Activity behaviours	Resistance to extinction shown after both CRF & VR schedules. Possible influence of instructions.
Wolf, Hanley, King, Lachowicz & Giles (1970)	Low-achieving children (N=16)	VI	Out of seat behaviour	Behaviour effectively managed by the "timer game"

Table 4, Continued

Authors	Subjects	Schedule Type	Target Behaviour	Outcome
Zifferblatt (1972)	Male psychiatric patients (N=12)	FR	Work & social behaviours	Token & social reinforcement superior to un-managed reinforcement. Token control greater than social. Ratio strain occurred.

2.7 Summary

Intermittent token reinforcement has been used in modifying a variety of non-verbal behaviours which include academic skills, motor tasks, work performance, social behaviour and self care behaviours. Subjects have been children, adolescents and adults; male and female; classified as autistic, delinquent, normal, retarded, alcoholic and schizophrenic; treated individually and in small groups. Token reinforcement has been delivered on fixed interval, variable interval, fixed ratio and variable ratio schedules with inconsistent results.

2.8 Token Reinforcement of Verbal Behaviour

The literature on the operant conditioning of verbal behaviour is extensive, as may be seen in Appendix A, but relatively few studies have been concerned with the use of token reinforcement and these will be reviewed here. The schedules of reinforcement used in these studies include continuous (CRF), fixed interval (FI), variable interval (VI), fixed ratio (FR) and variable ratio (VR).

Stuttering was the target in the first study reporting the use of token reinforcement in modifying verbal behaviour: Rickard and Mundy (1965) had as their subject a nine-year-old boy of superior intelligence who was effectively reinforced with tokens (points) for fluent speech. The tokens were administered on CRF and VI schedules and could be exchanged for back-up reinforcers. A follow up after six months found that a relapse had occurred. Reduced stuttering was also reported in a case study by Browning (1967) with a nine-year-old schizophrenic boy to whom tokens were administered contingently on a CRF schedule for fluent utterances, and fluency was maintained for a minimum of four days during extinction. A further single case study was reported by Leach (1969) in which a twelve-year-old boy was reinforced effectively for fluent speech with tokens (money) delivered on a CRF schedule but two months after treatment some dysfluency was apparent.

Ryan (1971) also reported case studies with four boys and a girl, ranging in age from six to nine years, in which the children were variously helped to establish fluent speech; and on follow up the children were found to have maintained their fluency. Tokens (points) were used with three of the boys only and were administered on a CRF schedule.

Ingham and Andrews (1973a), in a review of behaviour therapy and stuttering, refer to some of their own work: Ingham and Andrews (1968) incorporated a token system with a syllable-timed speech therapy procedure devised by Andrews and Harris (1964). Subjects were treated in out-patient groups of 10 for two weeks with a nine-months' follow up programme. Alford and Ingham (1969) used a similar programme with children which subsequently was developed by Ingham and Andrews (1971) for groups of four adults in a token economy in-patient programme. Subjects earned tokens according to performance on an individualised CRF schedule and they could also be fined. Details of the token system are described by Ingham, Andrews and Winkler (1972) and by Andrews (1973b). Andrews (1971) also provides a review of some of their work and Andrews and Ingham (1972) make an evaluation of follow-up procedures for syllable-timed speech/token system therapy.

A further study by Ingham and Andrews (1973c) involved 39 adult males ranging in age from 18 to 56 years

who were of above average intelligence and who had stuttered since childhood. The subjects were treated in groups of four within a hospital token economy programme and when they were formally assessed nine months after the completion of the project 65 per cent of those treated by the token system with graded auditory feedback were stutter free.

When the problem is one of articulation, rather than stuttering, tokens have also proved useful as McReynolds and Huston (1971) report in the first study to consider the effectiveness of token loss for incorrect responses in speech training with children. The tokens were earned on a CRF schedule by two boys, aged six and seven years, for correct responses, and the authors conclude that token loss can be effective in articulation training but consider that related variables should also be examined. They cite the work of Weiner (1962, 1963, 1964 and 1965) with regard to response cost in human subjects on a vigilance task in which points were earned on interval and ratio schedules of reinforcement. Weiner demonstrated that response cost decreased the frequency of responding, but its effectiveness was dependent on the number of points gained at reinforcement, the schedule of positive reinforcement, and the number of points lost per response. The subjects in Weiner's experiments were paid at a fixed rate for their participation and the points they earned were treated as being reinforcing

in themselves, i.e., unlike the points used as conditioned reinforcers in a treatment programme these could not be exchanged for back-up reinforcers. Furthermore, Weiner's subjects were in the main 'normal' young adults, so altogether it is not surprising that the results of McReynolds and Huston differ from those of Weiner.

Response cost (point loss) was used by Siegel, Lenske and Broen (1969) to modify speech dysfluencies in four female and one male student during spontaneous utterances. A point worth one cent was lost for each dysfluency uttered during a session, up to the maximum of 200 credited at the start of each session. Regardless of the outcome each subject received $2 per session for participating in the experiment. The authors report that dysfluencies were suppressed and kept at very low levels during the punishment procedures for all subjects except one of the female subjects and there was a general resistance to extinction. There was no way, however, to determine in the experiment just how necessary the money was as back-up reinforcement.

Dysfluent speech was also suppressed using response cost with 40 mental retardates aged 17 to 44 years in a study reported by Kazdin (1973a). Follow-up showed that response cost, i.e., withdrawal of unearned tokens, was more effective than aversive stimulation, and both were superior to feedback and no treatment in reducing the target dysfluencies.

Functional articulatory error was the target behaviour in a study reported by Rosso (1972) with 30 children between six and eight years of age who were assigned randomly to a social reinforcement group, a token reinforcement group or a control group, i.e., there were 10 children in each group. The results, however, did not indicate a difference in judged improvement as a consequence of treatment.

Group sessions, rather than individual treatment were used by Borus, Greenfield, Spiegel and Daniels (1973) to increase the verbal repertoire of four disturbed boys with severe language deficits. When a boy had learned to emit the desired target responses consistently with candy as a reinforcer, tokens were substituted, also on a CRF schedule, and they could be exchanged at the end of each session for back up reinforcers. Treatment sessions lasting an hour each were held three times a week for six weeks and the results were the same as expected for treating the children individually. This demonstrated a clear saving in therapist hours as more children could be treated per session.

Clark and Sherman (1975) showed that a relatively complex generative verbal repertoire could be established in language deficient children through modelling and reinforcement. The subjects were three retarded children, two boys and a girl ranging in age between 15 and 17 years, and four economically

disadvantaged children, three boys and a girl, ranging in age from three-and-a-half to four-and-a-half years. All seven children had limited speech but articulated some words and phrases clearly. Each child was trained to respond to questions with complete sentences. Praise, food and tokens were used as reinforcers; the tokens were used to earn toys. A first, each correct answer was reinforced on a CRF schedule but after two consecutive sessions with at least 40 per cent correct answers the reinforcement schedule was changed to VR2 for consecutive correct answers.

Steeves, Martin and Pear (1970) trained two autistic boys, aged 12 and 15 years, on a verbal and a printing task. Correct responses were reinforced on a CRF schedule with tokens exchangeable for popcorn on a 5:1 ratio. The purpose of the study was to determine if autistic children would voluntarily impose TO, i.e., time out from positive reinforcement, in the training sessions. It appeared that 30-second TO was reinforcing for the 15-year-old rather than being a punishment but the 12-year-old did not impose time out even when the back-up schedule was thinned from a token reinforcer ratio of 5:1 to 65:1. In addition, Harris (1975) cites a study by Guess, Rutherford and Twichell (1960) in which the verbal behaviour of previously non-verbal children was developed using token reinforcement.

Davidson (1970) paid $1.50/h to each of five undergraduate psychology majors and one high school student in a study in which free operant speech was the response manipulated. The subjects were trained to verbalise freely for points on FI schedules of 5, 10, 20, 30 and 50 second duration. Responding showed little or no correlation with the schedule; the subjects generally tended to respond at high rates with very few pauses regardless of the schedule of points delivered. Response-contingent flashes of white light were made available during the last half of each interval and this was found to be a rapid means of shaping schedule-specific behaviour. There was no back-up reinforcement.

Schwitzgebel (1967) informally recruited adolescent male delinquents at $1.00 an hour to have their thoughts and opinions tape recorded. The thirty-five subjects were assigned to one of three matched groups, i.e., two experimental groups and a control group, which were treated differently during the course of 20 tape recorded interviews on four classes of operants: hostile statements, positive statements, prompt arrival at work, and general employability. Hostile statements were followed by a mild aversive consequence (i.e., disagreement or inattention) while the other selected operants were followed by a positive consequence (i.e., verbal praise or a small gift). To determine what specific effects social reinforcers might

have, the first experimental group (N=9) received positive consequences for statements of concern (positive statements) about other people and for dependable and prompt arrival at work. The second experimental group (N=12) received negative consequences for hostile (negative) statements about people and positive consequences for socially desirable nonverbal behaviour. The mean age for the 35 subjects was 16.2 years with 9.1 years of completed schooling and an average of 1.4 years probation. Seven had been in custody previously for an average of 1.6 years. The control group (N=14) participated in only two interviews spaced over the same period of time as the other two groups. However, the authors are less than clear regarding the programming of contingencies and the precise nature of the schedules of reinforcement used:

> Positive consequences consisted of verbal praise, small gifts (e.g. cigarettes, candy bars, and cash bonuses in amounts varying from 25 cents to $1.00); negative consequences were inattention and mild verbal disagreement. All reinforcement attempts were delivered on a variable interval-variable ratio schedule. (p.137)

The precise nature of this schedule is unspecified. The only elaboration is the statement that each subject "received an average of six explicit reinforcement attempts on each of two variables" (p.137). It was found that the first experimental group had a significantly larger increase in positive verbal statements than the second experimental group and in comparison with the control group the result was even more significant. Since the frequency of positive

statements was altered with an average of only six reinforcement attempts the author considered that the control could have been accomplished by the informative or instructional properties rather than the rewarding or incentive properties of the rearranged consequences. But this alternative explanation was not explicitly investigated.

Henderson (1969) reported a programme in a token economy in a community-based facility for psychotic men aged 18 to 55 years. "Dual reinforcement" was used to modify verbal and motor acting out behaviour, by positive reinforcement with tokens ('grickles') and response cost (fining). Tokens were delivered on FI Schedules and the programme was considered to be of value in increasing desired verbal and motor behaviours such as friendly conversation and work. Variables that were not examined were the relationships between interval, magnitude and frequency of reinforcement.

Meichenbaum (1969) studied the relative effectiveness of verbal contingencies (praise and disapproval) in contrast to token contingencies (reinforcement and response cost), on the level of abstraction as measured by a proverbs task, and also on the percentage of "sick talk" emitted in structured interviews, with 48 male schizophrenic patients who were less than 50 years old. The subjects were randomly assigned to eight groups, six of which were experimental and two control; and a further 20

hospitalized male medical patients were used for comparison purposes. Healthy talk was reinforced with tokens on a CRF schedule and sick talk was punished by withdrawal of tokens, 10 of which were dispensed non-contingently at the start of each training session. Training in abstract interpretation of proverbs was carried out in a laboratory setting, show that the verbal and the token procedures decreased the percentage of sick talk and increased the level of abstraction, with the use of tokens being more effective. However, it is not possible to determine from the study the relative effectiveness of reinforcement and punishment.

Kazdin (1971a) reported a case study with a 29-year-old female retardate in which a response cost procedure was used to suppress psychotic verbalisations. After a baseline period of observation of the target behaviour lasting four weeks a threat of token loss was made whenever the response occurred in the following week. In the subsequent six-week period tokens were in fact withdrawn for psychotic talk. The tokens lost were those which had been earned for productive work in a sheltered workshop and response cost dramatically reduced the frequency of psychotic talk whereas threat on its own did not. The follow-up conducted over the following four weeks showed that the psychotic verbalisations were effectively eliminated.

Wincze, Leitenberg and Agras (1972) investigated the effects of token reinforcement and feedback on the delusional verbal behaviour of six male and four female chronic paranoid schizophrenic patients. The mean age of the patients was 44.9 years and they had been hospitalised for a mean period of 12.2 years. The results indicated that the effects of feedback were effective about half the time in reducing the percentage of delusional talk, but in at least three cases produced adverse reactions. However, token reinforcement showed more consistency and reduced the percentage of delusional verbal behaviour in seven of the nine subjects exposed to this procedure. The effects of both feedback and token reinforcement were quite specific to the environment in which they were applied and showed little generalisation to other situations. During token reinforcement phases, tokens were made contingent on non-delusional behaviour and given for every correct response. When the tokens were contingently given, the patients were informed that tokens had to be earned by "talking correctly". Also "for each minute that you talk correctly to nurses (i.e., an FI 60-second schedule) and for each question you answer correctly in sessions you will receive X tokens" (i.e., a CRF schedule). Tokens were exchangeable for primary reinforcers and privileges. A bonus token phase was added when a patient had a very low percentage of delusional talk on the ward. Each of the 10 subjects acted as their own control and a

counterbalanced sequence was employed for subjects 1 to 5 and 6 to 10 regarding the conditions of feedback and token reinforcement.

The aim of a study by Wilson and Walters (1966) was to increase the output of rational speech of 12 male schizophrenic patients, who ranged in age from 32 to 62 years with a mean age of 46 years. The subjects were individually treated in a soundproof room. The stimuli to elicit speech were 16 sets of 20 Kodachrome 35mm slides depicting everyday scenes and activities: a different set of slides was presented in each of the 16 training sessions. The first four subjects were exposed to a verbalising model and were reinforced contingently with tokens ("pennies") for speech whether this was in imitation of the model or not, (a model-plus-reinforcement group). Unfortunately, the details given about the scheduling of reinforcement are not sufficiently precise to enable replication:

> The reinforcement schedule utilized by any subject during a particular session was based on his performance on the previous session; a fixed-ratio schedule was set for each session such that reinforcement might be expected to occur on just over half the slides if the subject's speech output remained unchanged. (P.63).

A second group of four subjects (model-only group) was exposed to the model and received non-contingent reinforcement equivalent to that earned by the model-plus-reinforcement group. The third group of four, a control group, received the same "take-home" pay non-contingently. There was an

increase in verbal output in the first and second groups with the increase being more marked in the model-plus-reinforcement group. The authors conclude that a combination of a verbalising model plus reinforcement is more effective than the presentation of a model only. (But there is a further condition not examined and that is the effectiveness of token reinforcement without modelling in increasing the output of emitted verbal responses.) In addition the marked increase which occurred in the training sessions did not generalise to the ward setting even with the group of seven patients who were given 14 additional training sessions.

Both rational and psychotic speech were demonstrated to be under the control of token reinforcement contingencies by Bartlett, Ora, Brown and Butler (1971) in a case study of a 12-year-old autistic boy, especially when the contingencies were explained to him. The tokens were dispensed on a CRF schedule and were exchanged for money.

McClure (1968) investigated verbal social behaviour in two pairs of moderately retarded boys aged from 11 to 15 years who had acquired speech but who showed little social interaction with their peers. The boys were reinforced with tokens on an FR (unspecified) schedule for button pressing in the presence of a verbal social response (VSR), defined as a unit of speech or noise from both boys within five seconds. One pair failed to show consistent differences in

different VSR manipulations. The other pair showed little difference in target behaviour between FR token reinforcement, extinction and noncontingent reinforcement. A marked increase occurred only when verbal instruction was used in conjunction with token reinforcement.

Agras, Leitenberg, Wincze, Butz and Callahan (1970) report the effects of a CRF schedule of token reinforcement on the verbal social behaviour of a 21-year-old patient hospitalised for obsessive-compulsive disorders. In one experiment, instructions (free versus demand instructions) to talk with nurses were followed by instructions and noncontingent reinforcement. Conversations reliably increased only with contingent token reinforcement.

Zweback (1972) found that the verbalisation content in group therapy of eight hospitalised adolescents within the structure of an established token economy could be predictably controlled through the differential use of token reinforcement delivered on a VR3 schedule. Although overall experimental control was achieved there were obvious fluctuations and variations in the performance of individuals within the group.

Barton (1972) found that tokens were more effective reinforcers than candy in increasing the amount of social speech with four severely retarded females having an average age of 12.6 years. Reinforcement when contingent was given on a CRF schedule. She found that reinforcement with tokens and a cue light significantly increased the amount of social speech but the results of the four individual subjects were

very much more variable and, therefore, less clear than the group means. In addition, Barton (1973) reported a study with three profoundly retarded females ranging in age from 31 to 37 years in which they were conditioned to speak to each other, when isolated in a bare room, using token reinforcement. Inappropriate verbalisation (talking to the reinforcement dispenser) and appropriate speech (talking to each other) were each reinforced on a CRF schedule. Contingent reinforcement and the minimal use of prompts controlled the amount of the verbal operant whether it was appropriate or inappropriate speech.

Liberman (1972) reports research which aimed to increase the repertoire of verbal social behaviour of four female chronic schizophrenic patients who ranged in age from 39 to 55 years and who had been hospitalised for 15 to 30 years. Twenty-eight group sessions were held which lasted 50 minutes each during a six-month period. During the first 12 sessions (baseline) conversational interchanges occurred at the rate of one per minute and no difference was noted whether the nurse present actively prompted conversation or was passively responsive to the patients or whether the dayroom in which sessions were held was starkly or pleasantly furnished. Baseline was followed by four sessions of reinforcement in which tokens could be earned by the patients for talking to each other. The tokens were dispensed at the end of the session and could

be exchanged for such back-up reinforcers as candy, cigarettes and jewellery. A group contingency operated in which the total units of conversation were divided equally in four with each patient receiving the same number of tokens. For one session each in turn the patients wore a "bug-in-the-ear" device and were given praise on a VR4 schedule when contributing to the conversation: the praise took the standard form of the statement "very good", followed by the patient's name. The patient wearing the"bug-in-the-ear"received a bonus token at the end of the session for each time she was praised by the experimenter. The number of praise statements given ranged from 27 to 45. Noncontingent token reinforcement was dispensed at the start of the next four sessions equivalent to that of the preceding sessions, and during this phase the person wearing the "bug-in-the-ear" received praise statements during the periods she was silent for 20 seconds or longer. A final phase of contingent reinforcement lasted for eight sessions during which reinforcement was individualised, i.e., a patient received one token for each conversational unit she emitted. The "bug-in-the-ear" was again used in the same manner as in the first phase of contingent reinforcement. During both the phases of contingent reinforcement conversation was four to five times greater than either the baseline or noncontingent reinforcement conditions.

Bennett and Maley (1973) sought to increase verbal interaction between two chronic female schizophrenics in a token economy unit by making reinforcement contingent upon appropriate responding to the other patient. For every 50 seconds of target behaviour performance, one token was earned and the summated earnings were received at the end of each session. A control pair of patients were given the same instructions about the desired response but were not informed of any of the reinforcement contingencies. The performance of the experimental pair improved significantly in comparison with the control pair and generalisation effects were noted during the post-treatment phase. The study has a number of weaknesses which the authors mention: for instance, the effect of the behaviour of the experimenter is not clear and it is not known to what extent the use of instructions contributed to the outcome. But an unmentioned weakness is that the control pair were in effect reinforced for not responding.

Kazdin and Polster (1973) report the effect of intermittent token reinforcement after initial continuous token reinforcement on the verbal social behaviour of an adult male retardate in comparison with another subject who received only continuous token reinforcement. A dramatic decrease in social speech occurred with both subjects when continuous reinforcement ceased initially but this did not occur in a second period of extinction for the subject who by then had received intermittent token reinforcement.

Martin (1975) evaluated the use of token reinforcement in a group therapy setting with chronic, hospitalised, psychiatric patients. Fifteen patients were randomly assigned to two experimental groups and one control group, i.e., there were five patients in each of the three groups. Members of the two experimental groups received tokens on a CRF schedule for appropriate verbal interactions and under a yoked-control phase of non-contingent token reinforcement; the sequence of these phases was the major difference between the two experimental groups. The control group received no tokens. Results showed that the target behaviour occurred significantly more frequently, and for longer durations, in both the experimental groups under conditions of contingent token reinforcement as compared to conditions of non-contingent token reinforcement, and to baseline and extinction phases, and in both of the experimental groups as compared to the control group. Reversal procedures demonstrated the expected extinction effect. On follow-up there were no differential effects among the three groups as measured by the MACC Behavioral Adjustment Guide and the Hill Interaction Matrix - B.

Finally, Henson (1975b) reports the effect of token reinforcement on three classes of divergent verbal responding to verbal stimulus items from three measures of the Wallach-Kogan Creativity test. The subjects consisted of two "gifted", two "average", and two "learning

disabled" children from a public-school setting. The design utilised both an intra-subject and inter-subject multiple-baseline design with a reversal design added. Tokens were dispensed contingent upon the number of appropriate verbal responses to each stimulus item, i.e., a continuous schedule of reinforcement was used - one token per appropriate response. Consistently large effects of token reinforcement were observed, without generalisation of effect across the three classes of behaviours, or conditions.

2.9 Summary

Verbal behaviour has been modified by token reinforcement in studies in which the target behaviour has variously been stuttering, dysfluency, language deficit, free operant speech, psychotic speech, and desired verbal behaviour. Subjects have been: children, adolescents and adults; male and female; classified as autistic, delinquent, disturbed, normal, obsessive-compulsive, retarded, and schizophrenic; treated individually or in small groups but not in large groups. Token reinforcement has been delivered on continuous, fixed interval, variable interval, fixed ratio and variable ratio schedules but in no study using back-up reinforcement have schedules been systematically compared.

CHAPTER 3

EXPERIMENT I: THE EFFECT OF CONTINUOUS TOKEN REINFORCEMENT ON VERBAL BEHAVIOUR

> The evidence ... suggests the efficacy of partial reinforcement in everyday life. Learning is not greatly retarded by its use. (It appears, however, to be advantageous to use 100% reinforcement in establishing the desired behavior initially).
>
> Jenkins and Stanley (1950, p.230)

3.1 Introduction

A major deterioration in social functioning is a regrettable feature of the behaviour of human beings who have spent several years of their lives in mental hospitals. This phenomenon is well described by a number of authors, for instance, Gelfand, Gelfand and Dobson (1967), Greenblatt, Moore, Albert and Solomon (1963), Gruenberg (1967), Levinson and Gallagher (1964), Paul (1969), Stanton and Schwartz (1954), Ullmann (1967), Wing (1962), Wing and Brown (1970) and Zusman (1967). It is clear that the hospital environment maintains this behaviour and in general it is responsible for creating it, but until recently it was not so clear how the situation could be remedied. However, following the pioneering work of Atthowe and Krasner (1968), Ayllon and Azrin (1965), and Schaefer and Martin (1966) many studies have shown that operant conditioning principles can be used successfully to increase the social functioning of long-stay psychiatric patients. (A comprehensive survey of these studies is provided in Chapter 2.)

Institutionalised behaviour characterised by a marked lack of social interaction was a feature of the patients in an open long-stay male ward in Sunnyside Hospital, Christchurch, one of the largest mental hospitals in New Zealand. In fact, the ward was regarded as the one in the hospital with the most deteriorated male patients. The patients not only seldom spoke to each other but they scarcely spoke at all except to make simple requests of the staff. It was not that the patients had a deficient verbal repertoire for all except three or four of a total of 37 had been able to select from a printed list what they wanted for Christmas and to state their choice aloud for such articles as tobacco, cigarettes, chocolate, a pipe, a hairbrush or a wallet.

Each day from 9.30 to 10 a.m., a Ward Discussion Meeting was held "to air grievances and promote communication, to promote interest in world affairs, and to create awareness of the self and the surrounding environment". But rarely did a patient speak spontaneously; most frequently verbal responses came as the result of a direct question by a member of staff.

The same behaviour was noticeable in the weekly Wednesday morning quiz held by the ward's occupational therapy aide (OT) with the express intent of increasing the verbal participation of the patients in a social activity. She found the sessions to be generally unrewarding and it was from her stated dissatisfaction that the study reported in this chapter began.

The author hypothesised that the frequency of verbal responding by the patients would be increased if responses were contingently reinforced and that this could be achieved by the use of tokens with back-up reinforcement of cigarettes and chocolate. It was noticed that the patients actively participated in the weekly housie (bingo) session where these commodities could be won as prizes. Moreover, if the experiment were successful, not only would the patients have gained socially and materially, but it should also be possible to test the feasibility of maintaining this behaviour by means of intermittent reinforcement, specifically with the use of fixed ratio and variable ratio token reinforcement.

3.2 Method

Subjects. The ward had 37 beds and the number of patients remained the same throughout the period of four experiments, but there were some changes in the patient population itself. Details of all the patients are given in Appendix B with respect to age, years of hospitalisation, diagnosis and type of maintenance medication: this information was obtained from the patients' clinical files. At the start of Experiment I, of the 37 patients, 26 were diagnosed as schizophrenics, 5 as mental retardates, 3 as epileptics, 1 as involutional paraphrenic and 2 as Korsakoff's psychosis. The median age of the patients was 56 years with a range from 34 to 78 years.

The median period of hospitalisation was 22 years and ranged from 6 months to 38 years. The patients were the target population but not all took part in the study for a number of reasons, and Kazdin (1975) rightly criticises another account of this study (Horn and Black, 1973) for being unclear about the number of patients actually involved. It was possible for all 37 subjects to participate but data were analysed on 21 patients only: of the remainder, 3 were not on the ward for the duration of the experiment; 11 more were present but made fewer than a total of three responses each during the period of the study; and 2 preferred to work at jobs off the ward. (Details of the responding of all patients are given in Appendix C.)

Setting. Four experiments were conducted in the ward's large dayroom. The furniture consisted of two small tables at which patients could sit, a billiard table, and tubular-chrome-frame easychairs placed side by side around the dayroom with their backs to the wall. During Experiment I and Experiment II the patients sat in the chairs in rows at one end of the ward facing the quizmaster: during Experiment III and Experiment IV the patients were divided into groups of nine and each group sat in a semicircle facing the quizmaster. The studies were conducted in a "natural" setting rather than being carried out under laboratory conditions. This was deliberate as an aim of the programme was to undertake studies in conditions

normally experienced by the patients to show hospital staff that it was possible to increase the verbal social behaviour of patients in an already existing ward activity. Also in terms of experimental design it had the advantage of controlling for the effect of environmental change which Higg (1970) amongst others has shown can produce a significant improvement in the functioning of chronic patients on its own without the introduction of any new treatment measure. Furthermore, by studying an existing activity *in situ* it was likely that the effect of experimenter expectancy as discussed by Kintz, Delprato, Mettee, Persons and Schappe (1965) would be reduced as would the demand characteristics of psychological studies as outlined by authors such as Orne (1962).

Ward Staff. The number of nursing staff on the ward fluctuated unpredictably between one and four during the time of day that the studies were to be conducted and this pattern continued for the duration of the experiments. Rather than involve nursing staff it seemed better to use university psychology students to record data, and, where required, to act as quizmasters. The students had a knowledge of operant conditioning principles and they were directly responsible to the author in a way that would not have been possible with hospital staff. Also it was hoped that the studies themselves would attract the favourable interest of nursing staff and this, in fact,

occurred to the extent that the local branch of their professional association passed a recommendation that trainee nurses should be required as part of their training to become familiar with the programme. The use of students also avoided a difficulty in introducing the token programme to the institution for as observed by Krasner (1970b, p.83), "The experience of the author as well as other investigators in this area indicates that staff training is the most important element in the success of the token economy program." As it was, the nursing staff were of considerable assistance in a number of practical ways during the course of the experiments, and this was much appreciated.

Author's Role. During the experiments the author participated as a recorder only and at no stage during data collection did he interact with the patients. Interaction did occur at the end of each session when tokens were being counted and exchanged for back-up reinforcers (cigarettes and chocolate). In addition, the author was a familiar figure to the patients as for a year before the first study began he was present each Friday at the morning Ward Discussion Meeting and that morning's physical exercises. The patients were also told that he was in charge of the token programme which began in May 1972, and the last data collection in the final study was made in January 1974.

Design. The design chosen to test the effectiveness of continuous token reinforcement in increasing the frequency of verbal behaviour was the now standard ABAB design in which the subjects act as their own controls, and it is the most commonly used design in studies of token systems. The two A conditions are ones of no reinforcement and the two B conditions are ones with continuous token reinforcement. The study lasted for 16 weeks with a one hour quiz session per week held on Wednesdays from 10.30 a.m. to 11.30 a.m. conducted by the ward's OT. The OT was to resign her position at the hospital at the end of 16 weeks hence the arbitrary allocation of 4 weeks to each phase of the study.

Procedure. Each Wednesday morning at the Ward Discussion Meeting it was announced by the OT as previously that there would be the weekly quiz session at 10.30 a.m. and that all members of the ward were welcome to take part. (Attendance at the quiz was not compulsory and during it patients were free to come and go.) The form of the quiz varied from week to week in this study but it always dealt with questions of general knowledge. The only difference in the behaviour of the OT during baseline compared with her behaviour at previous quizzes was that she ceased to ask individual patients for the answers to questions. Instead she directed questions to the group as a whole and if there was no answer to a question she

would proceed to the next.

Responses made by the patients throughout the study were independently recorded by two observers seated on opposite sides of the group of patients. A response was scored if it was relevant to the quiz regardless of whether or not it was the correct answer but verbal behaviour that was not related to the quiz was not scored, for instance, a request for a cigarette or a match. Also if a patient repeated his response it was recorded as one response only but if two different patients gave the same response, a response was recorded for each. Furthermore, if one patient gave two or more different answers to the same question the equivalent number of responses were recorded. Such responding was relevant as the questions were generally of a nature that dealt with a category, such as the names of towns in a country, makes of motorcars, etc. The lists of questions were left to the OT to compile as she had done prior to the study.

In the second phase of the experiment verbal responses were reinforced contingently with tokens which could be exchanged at the end of each of the four sessions for back-up reinforcement in the form of cigarettes and/or chocolate. The tokens were dispensed on a CRF schedule for each participant, i.e., during the quiz itself each time a patient emitted a relevant verbal response, (on the

same criterion as for the baseline condition), he was given a token by the OT. The tokens were brown plastic discs specially made for the programme and were about the size of a New Zealand fifty cent piece, with a diameter of 35mm and a thickness of 2mm. The exchange ratios for back-up reinforcers were four tokens for a cigarette and eight tokens for a small bar of chocolate either standard or diabetic as required.

During the second phase of the study the OT announced at the Ward Discussion Meeting in the morning that there would be a quiz as usual and added that there would be prizes of cigarettes and chocolates for those who joined in. During the third phase, (a no reinforcement condition), she said at the morning meeting that there would be no prizes available that day in the quiz. During the fourth and final phase she made the same announcement as for the second phase and the token reinforcement procedure was followed as before.

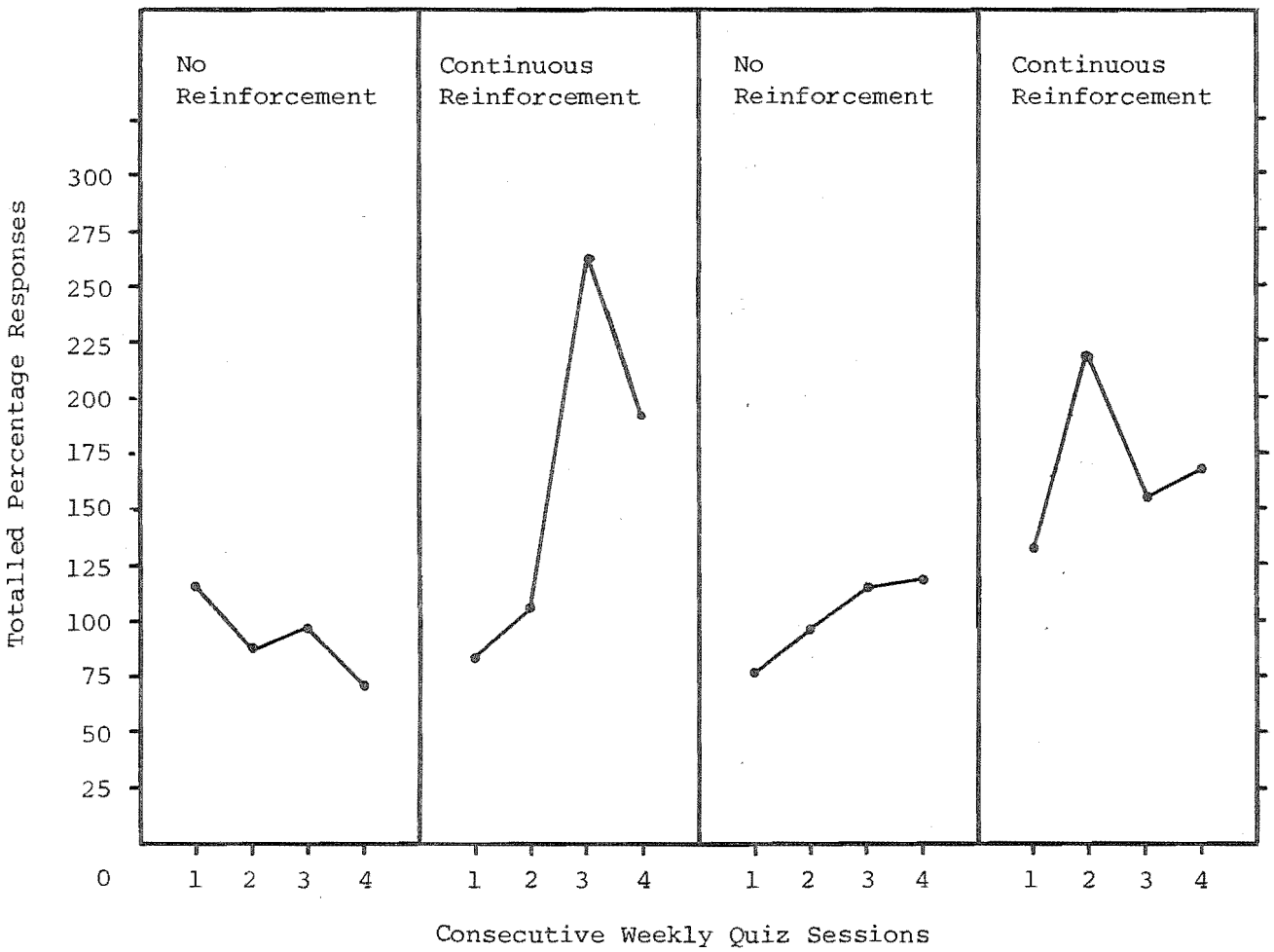


Figure 1. Verbal Responses of 21 Patients to Continuous Token Reinforcement.

Friedman Two-Way Analysis of Variance by Ranks for Verbal Responses of 21 Patients to Continuous Token Reinforcement

Sums of Ranks*						
NR1[a]	CR1[b]	NR2[c]	CR2[d]	df	χ_r^2	p.
67.5	50	57.5	35	3	16.4	< .001

* Ranking from highest to lowest scores

[a] No Reinforcement, Condition 1.

[b] Continuous Reinforcement, Condition 2.

[c] No Reinforcement, Condition 3.

[d] Continuous Reinforcement, Condition 4.

Table 5

3.3 Results

Agreement between the two recorders for the responses made by the patients ranged from 82.7% to 100%, with a median of 92.4%. These figures were obtained for 10 of the 16 sessions, i.e., for 62.5% of the time both observers were present. The agreement is sufficiently high to accept the reliability of data from the 6 sessions with only one observer especially as a check was provided by the number of tokens exchanged by patients at the end of each session for back-up reinforcement.

Only 21 of the patients participated in the quiz sessions, as specified above (see 3.2 Method: Subjects, for details, and Appendix C for the raw data.) The total verbal responses for the group are analysed in Table 5 using a Friedman two-way analysis of variance by ranks and the result is significant ($p < 0.001$). For display purposes only the responses were converted to percentages for each subject and then totalled for the group for each of the 16 sessions. The totals were graphed and are presented in Figure 1. The advantage of this sort of visual presentation is that it highlights the clinical effectiveness of the procedure used, as the rate of responding is equally balanced for each subject, i.e., the effect of low responding subjects is increased and that of high responding subjects is correspondingly reduced. For instance, if the response

rate of two patients quadruples from one condition to the next their percentage response change is the same when, in terms of actual responses, one may have changed from 5 to 20 and the other from 20 to 80. Clinically the importance of the change is the same for each. (The author is indebted to his supervisor for suggesting this form of visual presentation of data.) From Figure 1 it may be seen that the patients' rate of responding in the quiz sessions was increased in conditions of continuous token reinforcement and that it was higher than for conditions of no reinforcement. However, the first two sessions of continuous token reinforcement were exceptions in that the rate of responding did not rise above the baseline level. This may have been a practical consequence of introducing the token system for as commented by Horn and Black (1973, p.2): "To a certain extent (depending on the type of quiz) the rate of responding was dependent on the number of stimulus questions asked by the OT, and at first, her giving out of tokens reduced the amount of time in which she could ask questions, and so there was less time available in which responses could be given. Once she was familiar with the token-dispensing procedure, however, she was able to conduct the quiz with no disruption while dispensing tokens."

3.4 Discussion

As a pilot study this experiment was successful in a number of ways. It showed that it was possible to demonstrate the effectiveness of operant conditioning principles using continuous token reinforcement in increasing the verbal responding of chronic psychiatric patients, using a very large group in a natural setting with a minimum of interruption in existing procedures. However, it should be noted that only two-thirds of the patients responded; specifically of the 32 patients who were physically present throughout the experiment only 21 responded. As Kazdin (1973) has pointed out unresponsive patients are commonly found in token programmes, but generally the proportion is lower than that reported here. It could be that the large size of the group reduced the probability of responding of the most passive and withdrawn patients. It could also be that the limited range of back-up reinforcers reduced the effectiveness of the programme. In addition from studies with animals it has been found, as commented by Kelleher and Gollub (1962, p.594), that "Experiments directly comparing conditioned and unconditioned reinforcers have consistently demonstrated that the unconditioned reinforcer is more effective than the conditioned reinforcer." They also point out (1962, p.564) that "schedules of token reinforcement with exchange ratios resemble extended chained schedules", so

that the reinforcer effectiveness is likely further to be reduced. The question of the incentive value of generalised reinforcers is discussed by Kanfer (1960); all of which suggests that results achieved by token systems are likely to be conservative.

There were limitations too in the experiment itself: First, the stimulus questions were unstandardised. They differed in number and difficulty throughout the 16 sessions but it is unlikely that these differences occurred in any systematic way such as to bias the results in the expected direction.

Second, was definition of the target behaviour itself. High inter-observer agreement in recording responses indicates that the behaviour was adequately specified but the specification made it possible for undesirable verbal behaviour to be reinforced. For instance two patients (N, H and E, EF) were reinforced for echoing the responses of others.

Third, besides echoing the responses of others there were further ways of "beating the system". For instance, on one occasion a patient (D,CV) attempted to exchange 6 tokens more than the observers' records showed that he had received. It was found that he had obtained 4 of them from a patient new to the ward who did not fully understand the system and 2 others from a patient who said he did not want them anyway. Except for this incident no stealing or hoarding was noted.

Fourth, there were indications that variables other than the token programme itself were affecting participation. Some patients (e.g., T, CR and R,W) as may be seen from Appendix C, showed marked fluctuations in their responding from week to week; this was consistent with their other behaviour on the ward and appeared to be independent of changes in medication.

Fifth, with one patient (W,JH) a change in medication may have been a confounding factor when his response rate quadrupled (i.e., from 4 to 16 responses in the same reinforcement condition) the day following the change. But he also changed his usual seating position and sat beside a high responder who may well have acted as a model. On the other hand high rates of responding by some patients may have had a suppressive effect on the participation of others. However, the amount that such unprogrammed contingencies contributed to changes in behaviour was still not as great as the effect of the token programme when the group is considered as a whole: for as the two phases of no reinforcement show (baseline and extinction) despite individual fluctuations participation by the group remained markedly stable.

In conclusion, it may be said that the control exerted by token reinforcement administered on a CRF schedule was remarkable considering that the quiz was held for

only one hour per week. In addition the effectiveness of the programme indicated the feasibility of systematically investigating the influence of ratio schedules of token reinforcement on verbal behaviour.

CHAPTER 4

EXPERIMENT II: ESTABLISHING TOKENS AS CONDITIONED REINFORCERS OF VERBAL BEHAVIOUR

4.1. Introduction

In Experiment I it was found that in the first two sessions with continuous token reinforcement that the response rate showed no increase on the previous baseline level. It was suggested that this initial low responding was the result of the slowness of the quizmaster in dispensing tokens as the practical requirement of dispensing tokens reduced the amount of time in which questions could be asked and therefore in which responses could be given. An alternative explanation put forward by Samuels and Black (1974) is that the tokens had not in fact at that stage become conditioned reinforcers.

Kelleher and Gollub (1962 p.593) in discussing what variables determine the reinforcing strength of a conditioned reinforcer conclude that "amount of primary reinforcement, and frequency or probability of primary reinforcement are effective in determining conditioned reinforcement strength. In addition to these variables, number of pairings of, and duration of interval between conditioned and primary reinforcers affect the potency of a conditioned reinforcer". Following on from the last comment it could therefore be that in Experiment I the interval of up to 1 hour between receiving the tokens

and exchanging them for back-up or primary reinforcement was too long a period in which to establish the tokens as conditioned reinforcers. In addition, as Skinner (1963) puts it, "There is no reason why a description of contingencies of reinforcement should have the same effect as exposure to the contingencies", and work by Ayllon and Azrin (1964) has underlined this point.

It was hypothesised that the tokens could be established as conditioned reinforcers immediately if the exchange of the tokens for back-up reinforcement was also immediate. The effectiveness of this procedure would be demonstrated by a sharp increase in the response rate when tokens were introduced.

4.2. Method

Subjects

The 37 patients on the ward were the target population and 6 of them were new to the ward, i.e., they did not take part in Experiment I, but it was possible for them to participate in Experiment II, Experiment III and Experiment IV. Characteristics of the 37 patients who could participate in these three Experiments are given in Appendix B, with respect to age, years of hospitalisation, diagnosis and type of maintenance medication. Of the 37 patients data were analysed on 25 patients only: of the remainder, 10 were present but made fewer than a total of 3 responses each during the period of the study: one preferred to work at a job off the ward: and one preferred to work at a job on the ward. (Details of the

responding of all patients are given in Appendix D).

Setting

The setting was the same as for Experiment I and is outlined in Section 3.2 above, and as in the first study patients were free to come and go while the quiz was in progress and attendance at it was not compulsory.

Design

The design chosen to test the hypothesis was an ABAB but it differed in some respects from that of Experiment I. Since most of the subjects had had previous experience of token reinforcement, the test of the hypothesis rested most clearly on performance of the naive subjects, i.e., those who were not on the ward during Experiment I, and on the subjects who were present during the first study but who did not experience reinforcement because of making too few responses. Following Barton (1972) the design includes non-contingent reinforcement. The conditions were as follows:

I. Baseline (non-contingent reinforcement)

II. Contingent reinforcement with immediate exchange of tokens for back-up reinforcers.

III. Extinction (non-contingent reinforcement)

IV. Contingent reinforcement with delayed exchange of tokens.

The exchange ratio of tokens for back-up reinforcement was the same as for the previous study, i.e., 8 tokens for a bar of chocolate and 4 tokens for 1 cigarette.

But to enable a shorter interval between receiving a token and exchanging it for back-up reinforcement, the chocolate bars were broken into 8 pieces so that in Condition II each response earned 1 token which was immediately exchanged for 1 piece of chocolate. The cigarettes could not usefully be divided into four pieces so 4 tokens had to be saved before they could be exchanged for a cigarette. But this exchange took place as soon as 4 had been saved rather than at the end of the session. By these means the interval between receiving a token and exchanging it for back-up reinforcement was reduced to a few seconds or minutes for Condition II, instead of being up to an hour as in the previous study, and in Condition IV of this study.

Procedure

Each Tuesday and Wednesday morning at the Ward Discussion Meeting, it was announced by the Charge Nurse that there would be a quiz session. On Wednesday the quiz was announced for 10.30 a.m. for an hour, and on Tuesday it was announced for 11 a.m. for an hour. All members of the ward were welcome to take part. There was a total of 14 sessions during a period of 8 weeks starting in March 1973. No sessions were able to be held in the seventh week, and this increased the time between sessions 1 and 2 of Condition IV by a week.

Before each quiz session under Condition I, the quizmaster told the patients that there would be chocolate and cigarettes given to everyone at the end of the quiz. Under Condition II he told them that there would be prizes to be earned during the quiz, and every answer they gave would earn a token which could be exchanged immediately for a piece of chocolate or, as soon as 4 tokens had been earned, for a cigarette. Under Condition III, the same instructions as for Condition I were repeated. And before each session under Condition IV patients were told that tokens would again be received for all answers made but they would have to wait until the end of the quiz before exchanging them for chocolate or cigarettes.

The amount of chocolate and cigarettes given to each patient as non-contingent reinforcement at the end of each session under Conditions I and III was equivalent to 16 tokens (i.e., 4 cigarettes or 2 bars of chocolate or a combination of both). This value was approximately that gained on the average during the first study.

The stimulus questions during the quiz were of a general knowledge type and were chosen from children's quiz books of about the Standard Six level of difficulty. The questions were directed to the group as a whole rather than to individual members, i.e., the same procedure as for Experiment I. The questions, however, in this study were standardised to overcome a weakness in the previous study

in which the number of opportunities for responding varied with each quiz. To overcome this variation 100 questions per quiz were used in this Experiment. However, while 100 questions could be used during an hour in Conditions I and III, only 50 questions could be asked during an hour in Conditions II and IV owing to the marked increase in response rate and the extra time taken in dispensing tokens and back-up reinforcers. The quizmaster throughout the study kept social interaction with the patients as constant as possible, this included smiling and one-word statements such as "yes", "no", "good", etc.

As in Experiment I an answer was recorded as a response, whether it was correct or not, provided it was relevant to the quiz and directed to the quizmaster. If the answer was repeated by the same person it was recorded only once, but if two people gave the same answer each was credited with the response, and if one person gave two answers to the same question, two responses were recorded.

Unlike the previous study the quizmaster did not dispense tokens. During Condition II and Condition IV tokens were dispensed on an CRF schedule to patients when they made responses by another person who walked quickly between the rows of chairs. In Condition II in which tokens could be exchanged immediately for back-up reinforcement, a further person followed and exchanged

the tokens immediately for chocolate and cigarettes. During Condition IV the tokens were not exchanged until the end of the quiz as for Experiment I.

The quiz sessions were also attended by two and sometimes three recorders. The agreement between them was calculated according to the formula:

$$\text{Reliability} = \frac{\text{No. of agreements}}{\text{No. of agreements} + \text{disagreements}} \times \frac{1}{100}$$

This formula gives on the average as Samuels and Black (1974) point out, 10% - 15% more conservative reliability coefficients than that used in the previous study, so it was preferred as giving coefficients closer to the true reliability of scoring.

4.3. Results

Agreement between the recorders ranged from 62.4% to 91% with most reliabilities being in the mid seventies. While these figures are satisfactory they should be viewed in the light of Romanczyk, Kent, Diament and O'Leary's (1973) paper concerning difficulties involved in the observing and recording of behaviour. With the lowest reliability in this study being 62.4%, it appeared that the group being observed was approaching the maximum size which two recorders could observe accurately.

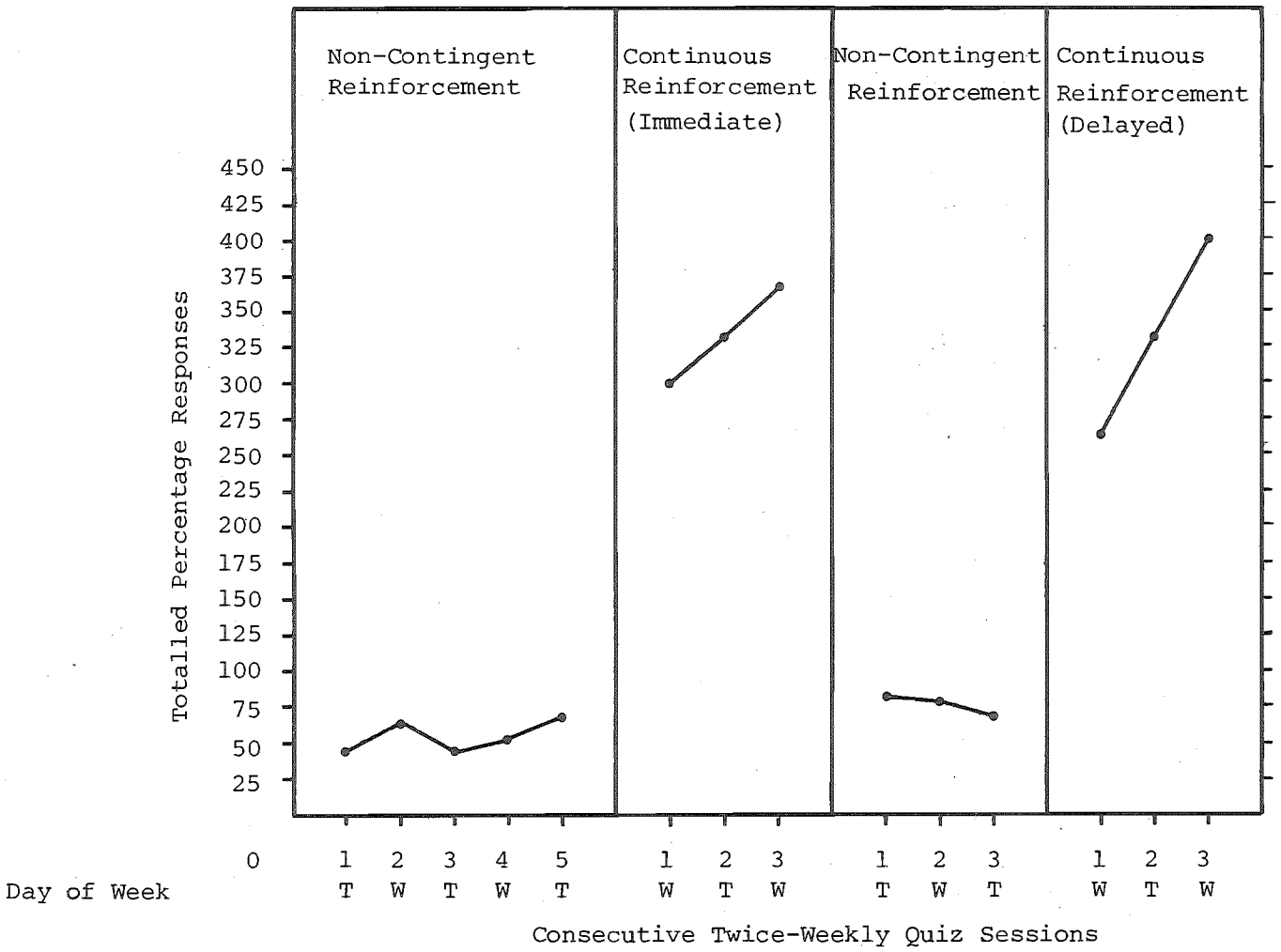


Figure 2. Verbal Responses of 25 Patients to Continuous Token Reinforcement with Immediate and Delayed Back-up Reinforcement.

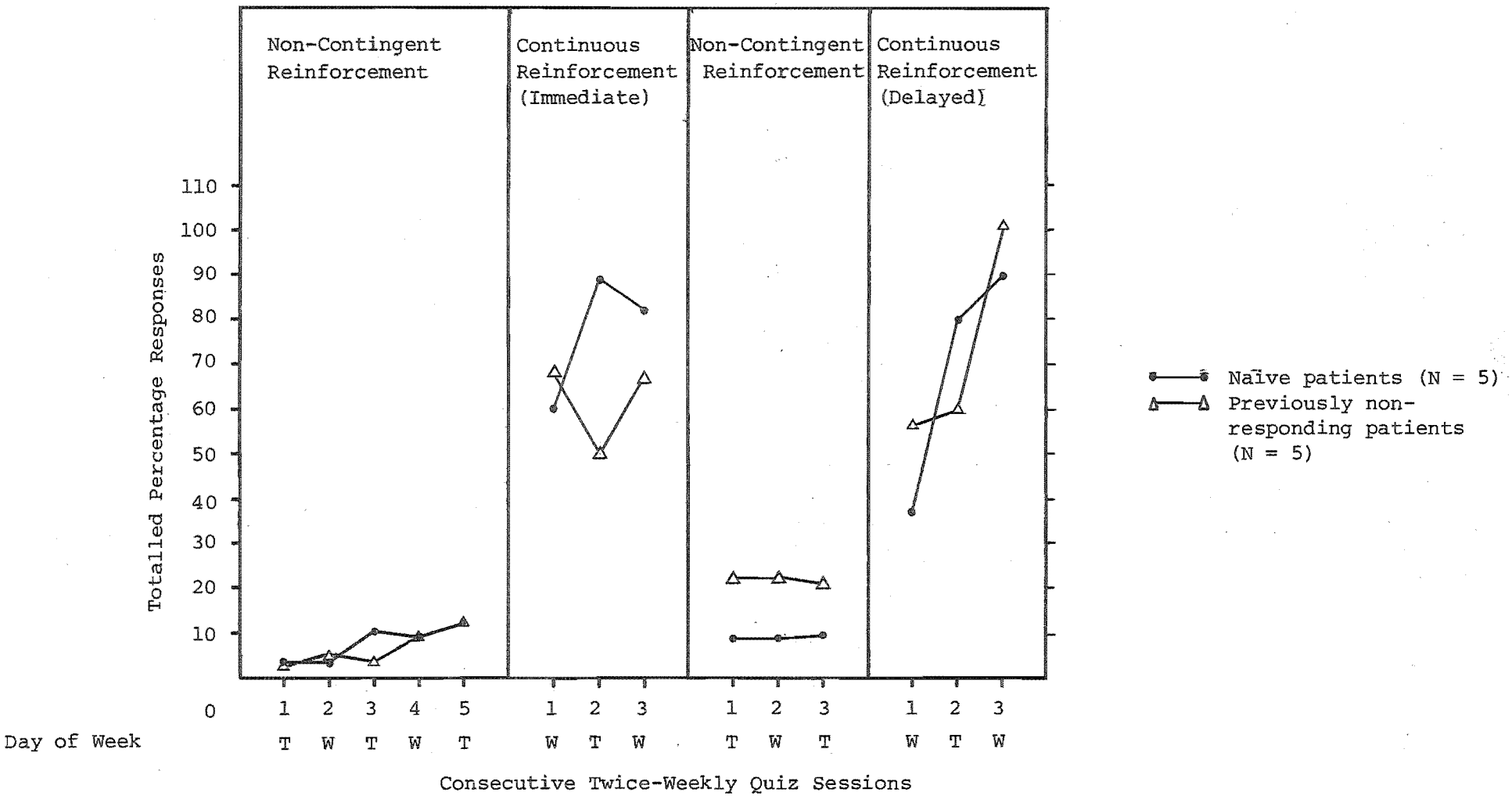


Figure 3. Verbal Responses of 10 Patients (with no history of token reinforcement) to Conditions of Immediate and Delayed Back-up Reinforcement.

Friedman Two-Way Analysis of Variance by Ranks for Verbal Responses of 25 Patients to Continuous Token Reinforcement with Immediate and Delayed Back-up Reinforcement.

Sums of Ranks*				df	$\chi^2 r$	p.
NCR1[a]	CR1-I[b]	NCR2[c]	CR2-D[d]			
83.5	39.5	86.5	40.5	3	48.2	< .001

* Ranking from highest to lowest scores

[a] Non-Contingent Reinforcement, Condition 1.

[b] Continuous (Token) Reinforcement - Immediate, Condition 2.

[c] Non-Contingent Reinforcement, Condition 3.

[d] Continuous (Token) Reinforcement, - Delayed, Condition 4.

Table 6

Friedman Two-Way Analysis of Variance by Ranks for Verbal Responses of 5 Naive Patients to Continuous Token Reinforcement with Immediate and Delayed Back-up Reinforcement

Sums of Ranks*						
NCR1[a]	CR1-I[b]	NCR2[c]	CR2-D[d]	df	$\chi^2 r$	p.
18	7	17	8	3	12.2	< .01

* Ranking from highest to lowest scores

[a] Non-Contingent Reinforcement, Condition 1.

[b] Continuous (Token) Reinforcement - Immediate, Condition 2.

[c] Non-Contingent Reinforcement, Condition 3.

[d] Continuous (Token) Reinforcement, - Delayed, Condition 4.

Table 7

Friedman Two-Way Analysis of Variance by Ranks for Verbal Responses of 5 Previously Non-Responding Patients to Continuous Token Reinforcement with Immediate and Delayed Back-Up Reinforcement.

Sums of Ranks*				df	χ^2_r	p
NCR1[a]	CR1-I[b]	NCR2[c]	CR2-D[d]			
19	8	16	7	3	12.6	<.01

*Ranking from highest to lowest scores

[a] Non-Contingent Reinforcement, Condition 1.

[b] Continuous (Token) Reinforcement - Immediate, Condition 2.

[c] Non-Contingent Reinforcement, Condition 3.

[d] Continuous (Token) Reinforcement, - Delayed, Condition 4.

Table 8

Only 25 of the patients on the ward participated in the quiz sessions (see 4.2 Method, Subjects, for details and Appendix D for the raw data). The total verbal responses for the group are analysed in Table 6 using a Friedman two-way analysis of variance by ranks and the result is significant ($p < 0.001$). For display purposes only the responses were converted to percentages for each subject and then totalled for the group for each of the 14 sessions in the same manner as for Experiment I. The totals were graphed and are presented in Figure 2. Under both conditions of contingent token reinforcement, i.e., with immediate and delayed back-up reinforcement the increase in response rate is immediate and sharp, demonstrating considerable control over the patients' verbal behaviour. The same abrupt changes in behaviour are demonstrated by 10 of the patients with no history of token reinforcement: Table 7 and Table 8 present analyses of data on 5 naive patients and 5 previously non-responding patients, respectively, and in each instance the result is significant ($p < 0.01$). For display purposes only the responses have been converted to percentages for each subject and then totalled for each group of 5 for the 14 sessions and are presented in Figure 3.

In terms of the total number of responses, approximately 300 were made per session during Conditions I and III and during Condition II and IV the equivalent of 1200 responses were made per session.

4.4 Discussion

As Samuels and Black (1974) comment: "the institution of the immediate exchange of tokens for back-up reinforcers swiftly established the tokens as conditioned reinforcers". This is demonstrated by the sudden and pronounced increase in response rates of patients who had never before experienced token reinforcement. It may therefore be concluded that the low responding obtained in the initial two sessions of token reinforcement in Experiment I was due to the tokens not having yet acquired reinforcing properties at that stage. Once the tokens in the present study were established as conditioned reinforcers they also continued to have a reinforcing effect even when there was a delay of up to an hour between receiving and exchanging them; this is demonstrated by the maintenance of a high response rate in Condition IV.

Baseline and extinction phases (Conditions I and III) which included non-contingent reinforcement in this experiment produced a total number of responses per session equal to that achieved in the second token reinforcement phase of the first study. It therefore

appears that the non-contingent reinforcement had a positive effect on responding. But the contingent reinforcement phases in this study (Conditions II and IV) produced a total number of responses just over four times the maximum achieved in the previous study. This difference demonstrates the potency of the method described in this second experiment.

The study underlines the practical importance of establishing that tokens are in fact conditioned reinforcers. It cannot be assumed that they will become such only by explaining to patients just what the tokens are worth and how they may be exchanged for back-up reinforcement. A quick and efficient method is to provide an immediate exchange of tokens for back-up reinforcers in the initial stages of a programme. Having stated this, however, there were still a number of patients who although physically present for the experiment did not respond.

In comparison with Experiment I the stimulus questions were standardised but it was still possible for undesirable verbal behaviour to be reinforced, for instance patients echoing others.

A limitation of standardising the questions was that it reduced the number of responses in that there were clearly specifically correct answers. It would appear to be an advantage to have stimulus questions of a nature which encourages more than one response per patient.

CHAPTER 5

EXPERIMENT III: THE EFFECT OF FIXED RATIO SCHEDULES OF TOKEN REINFORCEMENT ON VERBAL BEHAVIOUR

5.1 Introduction

The results of Experiment I and Experiment II show quite clearly that the verbal behaviour of long-stay psychiatric patients may be brought under the functional control of token reinforcement when administered on a CRF schedule. The behaviour showed a marked decrease in extinction which is characteristic of behaviour previously reinforced on a CRF schedule whether this is in animals or in humans. The effects of extinction on behaviour that has previously been reinforced with ratio schedules is not so clear. This study, Experiment III, was designed to test the effect of fixed ratio schedules of token reinforcement on verbal behaviour.

Ferster and Skinner (1957 report that fixed ratio schedules generate high rates of responding and a long history of FR reinforcement will maintain responding during extinction for a much greater length of time than would continuous reinforcement. This finding is based on work carried out with animals, but as may be seen from Chapter 2 above it is not clearly supported from work with humans using intermittent schedules of token reinforcement (see Section 2.6) or, more particularly, where the research is on the token

reinforcement of verbal behaviour (see Section 2.8). Furthermore in no studies have the effects of differing fixed ratios on the target behaviour been systematically examined. The aim of the present study is to do that with regard to verbal behaviour of the type studied in Experiment I and Experiment II.

In their review of partial reinforcement Jenkins and Stanley (1950 p.227) observe: "All other things equal, resistance to extinction after partial reinforcement is greater than that after continuous reinforcement when behaviour strength is measured in terms of single responses." Later, Lewis (1960 p.2) comments: "Nine years and a great deal of research later this generalisation still stands, perhaps more firmly than ever." Jenkins and Stanley (1950 p.230) also make the observation that "the most striking aspect of the data is the far greater resistance to extinction found after partial reinforcement as compared with continuous. If one desires behaviour to be maintained for long periods of time in the absence of externally presented reward, partial reinforcement should be used in training. This generalisation appears to hold whether one is interested in having a rat press a bar or in maintaining a child's proper toilet habits or table manners. Implications of the procedure for the practical prediction and control of behaviour are obvious."

The hypothesis tested in this study is that resistance to extinction following fixed ratio schedules of token reinforcement will be inversely related to the size of the ratio.

5.2 Method

Subjects

The 37 patients on the ward were the target population, once again, of this study. They were the same individuals who resided on the ward during Experiment II and they are also the subjects for Experiment IV. Details of all the 37 patients in the target population are given in Appendix B with respect to age, years of hospitalisation, diagnosis and type of maintenance medication.

It was possible for all 37 subjects to participate in this study but data were analysed on 26 patients only: of the remainder, 1 was not on the ward for the duration of the experiment; 9 more were present but made fewer than a total of three responses each during the period of the study; and 1 preferred to work at a job off the ward. (Details of the responding of all patients are given in Appendix E). In this study the population of the ward was divided into four groups, i.e., three groups of nine and one of ten.

Design

This study followed on directly from the previous experiment and was conducted in the months May through

to July 1973. The major increase in responding that occurred in Experiment II meant that it was no longer feasible to observe the patients accurately if they were retained in one large group. As mentioned above they were divided into four groups, with ten patients in Group I and nine patients each in Groups II, III and IV. Patients were allocated to groups on the basis of the mean number of responses per session that each had made during the previous study. They were divided into high, low, and non-responders, and randomly assigned from each of these divisions to the four groups. In this way it was expected that there would be an even distribution of high, low and non-responders in the four groups. Sixteen quiz sessions were held for each group twice weekly for half an hour for a period of eight weeks. Originally the design was for five phases with three sessions a phase, as on the basis of the previous study it was shown that three sessions were all that was needed for a new contingency to take effect and for behaviour to stabilise. However, four sessions rather than three were held in phase 5 to avoid changing to a new procedure after the delay of nearly a week. Changes of procedure occurred on the second session of the week, i.e, on Wednesdays with a first session being held on Tuesday, with the exception of the change between phase 2 and phase 3. The experimental design is outlined in Table 9.

EXPERIMENTAL DESIGN FOR EXPERIMENT III SHOWING PHASES OF FIXED RATIO TOKEN REINFORCEMENT

	Phases				
	1	2	3	4	5
Sessions	1-3	4-6	7-9	10-13	14-16
Group I	Non-contingent reinforcement (NCR)	100%	100%	100%	Extinction
Group II	NCR	100%	66%	66%	Extinction
Group III	NCR	100%	33%	33%	Extinction
Group IV	NCR	100%	66%	33%	Extinction

Table 9

As the previous experience of the patients with token reinforcement had been in a large group setting it was decided to begin the study with three sessions of non-contingent reinforcement to obtain baseline data for the subjects as they were now divided into small groups. This was phase 1 for all groups. Group I was reinforced on a CRF schedule, i.e., 100% of responses were reinforced for phases 2, 3 and 4; in phase 5 there was no reinforcement either with tokens or with non-contingent reinforcement. Group IIwere reinforced on a CRF schedule in phase 2, and in phases 3 and 4 they were reinforced on an FR 66% schedule, i.e., the first 2 of each 3 consecutive responses per patient were reinforced; in phase 5 there was no reinforcement. Group III were reinforced on a CRF schedule for phase 2 but for phases 3 and 4 experienced FR 33% token reinforcement i.e., the first of each 3 consecutive responses made by a patient was reinforced; in phase 5 there was no reinforcement. Group IV were reinforced on a CRF schedule in phase 2, an FR 66% schedule in phase 3, an FR 33% schedule in phase 4, and in phase 5 as with the other groups no reinforcement was dispensed.

It was predicted that resistance to extinction would be shown by the groups in the following order Groups IV, III, II and I. Group IV would have the most varied reinforcement history and so it was predicted

that its resistance would be greater following Kimble (1961). Group IV was included as a comparison group in case Group III broke down under ratio strain in the change from phase 2 to phase 3. (It was predicted that Groups III, II, and I would show decreasing resistance to extinction.) The clearest test of the hypothesis would be shown in comparing phase 5 (no reinforcement) with phase 2 (100% reinforcement).

Procedure

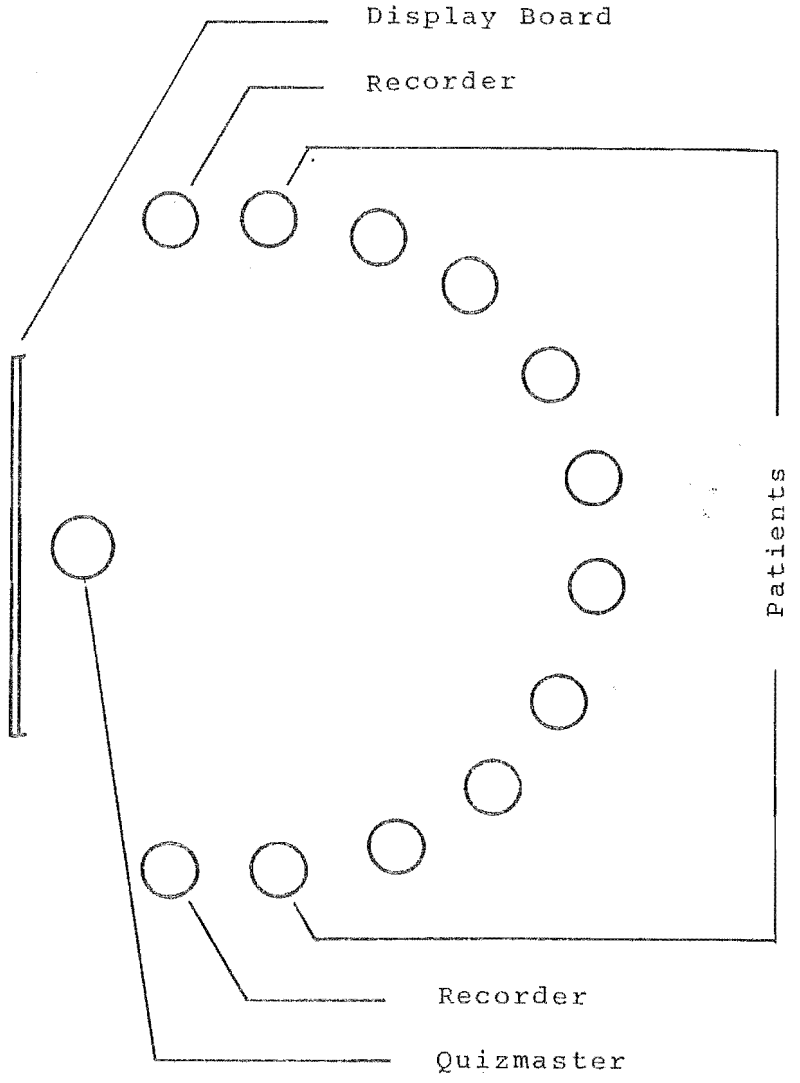
The procedure followed in this study was similar to that followed in Experiment II. Each Tuesday and Wednesday morning at the Ward Discussion Meeting the Charge Nurse announced that there would be a quiz session for everyone at 11 a.m. and 10.30 a.m. respectively for the two days. The patients were divided into four groups as described above and every group had a half-hour session on each day as follows:

	Tuesday	Wednesday
Group I Group II	11.00-11.30	10.30-11.00
Group III Group IV	11.45-12.15	11.15-11.45

Two half-hour quiz sessions were run concurrently and these were held at opposite ends of the day room. The patients in the two groups not taking part were free to sit in easy chairs or move about as they chose. They could overhear what was occurring in the quiz sessions,

so to avoid this influencing their future responses in the second sessions of the morning the order of questions was modified in those later sessions.

Each group had its own quizmaster who stood in front of a large display board mounted on an easel. A large sheet of paper was pinned to the display board and within arm's reach of the quizmaster was a box of tokens. The nine to ten patients in the group sat in a semicircle of easy chairs facing the quizmaster and the display board and the two recorders sat at opposite ends of the semicircle as in the diagram below:



The quiz consisted of open-ended type questions in which the specific target behaviour was novel responding to general stimulus questions. When a novel response was made the quizmaster printed it with a large wax crayon on the paper pinned to the display board and then when appropriate immediately placed a token in the hand of the subject who had made the response. The next response was then rewarded in the same way. The two observers independently recorded the novel responses made by the patients and these were totalled for each patient at the end of the session. Alongside each name the total of tokens received was recorded as a check to see that none had been acquired from another patient and that none were being hoarded. Only responses recorded on the display board were reinforced with tokens when appropriate. Unrelated verbal activity was not recorded and neither was a response which had already been made either by the patient himself previously or earlier by another patient. However, if two patients simultaneously made the same response, both were reinforced.

During the experiment the following topics were covered in the quiz sessions beginning with a stipulated letter of the alphabet:

(a) The names of towns and countries.

(b) The names of famous people.

(c) The names of living things (i.e., animals and plants).

(d) First names and surnames of people.

The topics were worked through in the order above for all groups but Group I and Group II started with letter A and continued through to Z as directed by the quizmaster, while Group III and Group IV started with Z and worked back to A.

At the beginning of each session the quizmaster said: "I want you to give me the names of all the (e.g., towns and countries) you can think of beginning with the letter (A ... Z)."

For phase 1 (non-contingent reinforcement) the patients were told at the beginning of each session that they would receive four cigarettes or two small bars of chocolate at the end of the session. No tokens were dispensed but at the start of the study several patients did ask if they were going to be given tokens.

For phase 2 (100% token reinforcement, i.e., CRF or FR1 schedule) sessions the patients were told: "You will get tokens for new answers which can be exchanged at the end of the session - four tokens for a cigarette, eight tokens for a bar of chocolate, or two tokens for some sweets."

For phases 3 and 4, Group I continued to receive the same instructions. For phases 3 and 4, Groups II, III and IV were told: "You will receive a token for each new answer as before, but not all the time."

For phase 5 (extinction) all groups were told: "No tokens will be used today", at the start of each session and non-contingent reinforcement was not given. When asked why there were no prizes patients were told that the supply of cigarettes and chocolate had run out. (However, it should be noted that at all times patients continued to receive their normal weekly allowance of these commodities. It so happened that these were distributed on a Wednesday afternoon so that during the course of the studies the patients were in a mild state of deprivation; the only other time they could be obtained was as prizes at housie (bingo) which was held on Friday afternoons.)

During each session when no response had occurred for thirty seconds, the quizmaster said: "Are there any more words beginning with the letter (A ... Z)?". If there was no response after a further 10 seconds, the quizmaster said: "Give me the names of all the (towns and countries) you can think of beginning with the letter ... (i.e., the next letter)." At the end of the half hour the quizmaster signalled the end of the session with the statement, "That's all". Tokens received by each subject were then counted and exchanged for back-up reinforcements.

When tokens were being dispensed on an FR66% schedule the first two of each three consecutive responses per patient were reinforced by the quizmaster. He was cued by one recorder with the word 'yes' if a response was to be reinforced and the word 'fine' if it was not to be reinforced. The same procedure was used with the FR33% schedule when the first of every three consecutive responses per patient was reinforced with a token by the quizmaster.

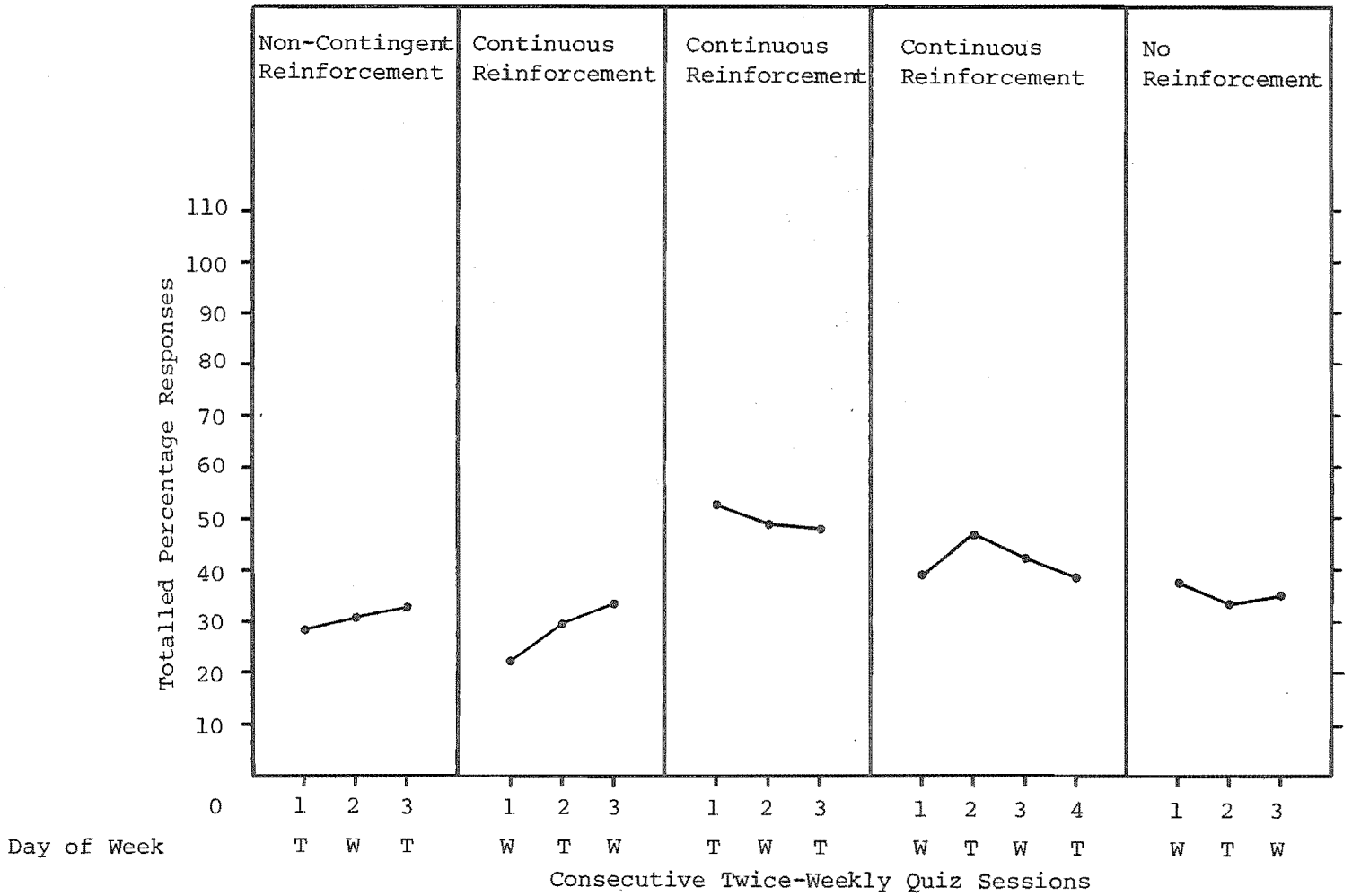


Figure 4. Verbal Responses of 6 Patients (Group I) to Continuous Token Reinforcement.

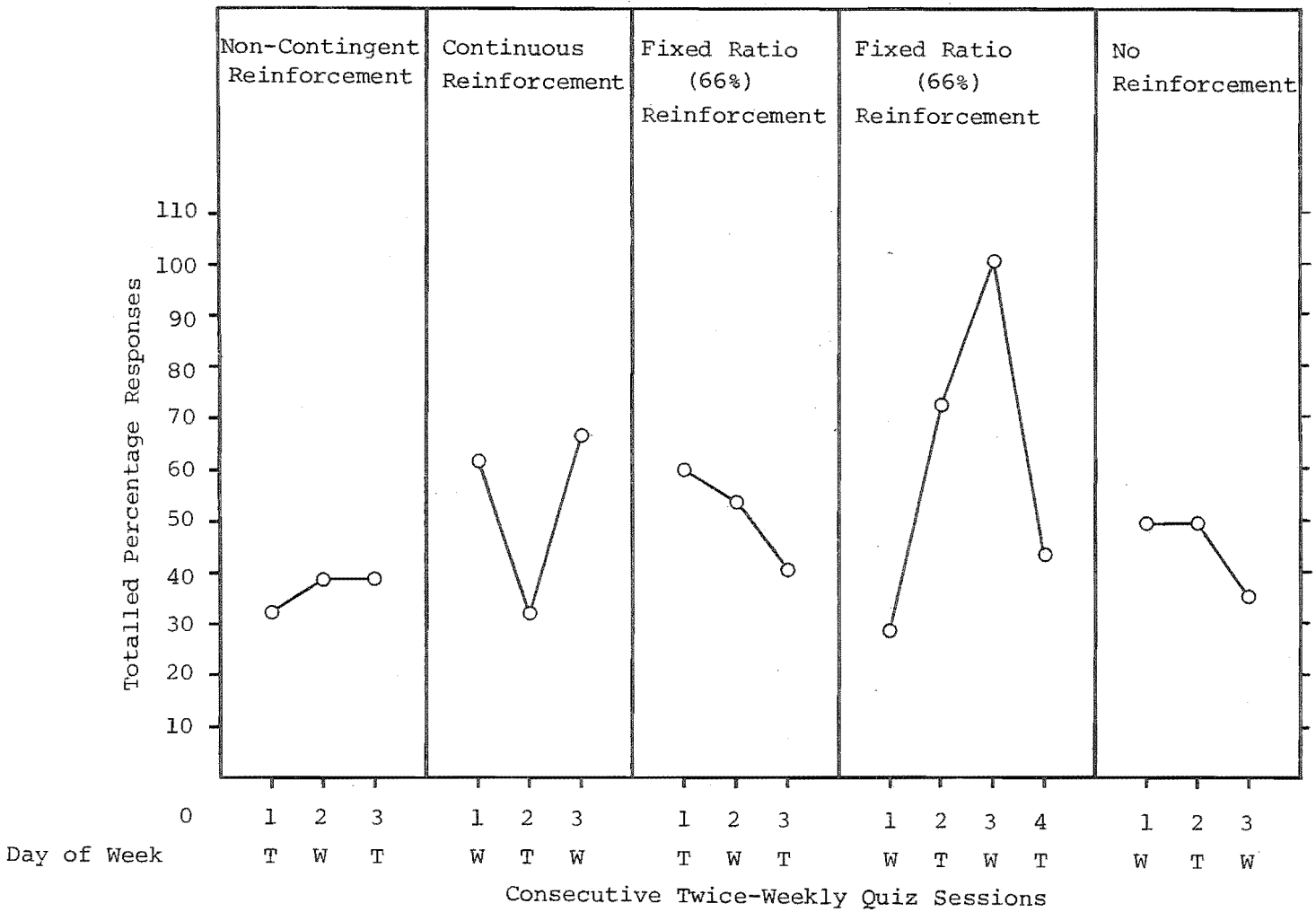


Figure 5. Verbal Responses of 8 Patients (Group II) to Continuous and Fixed Ratio Token Reinforcement.

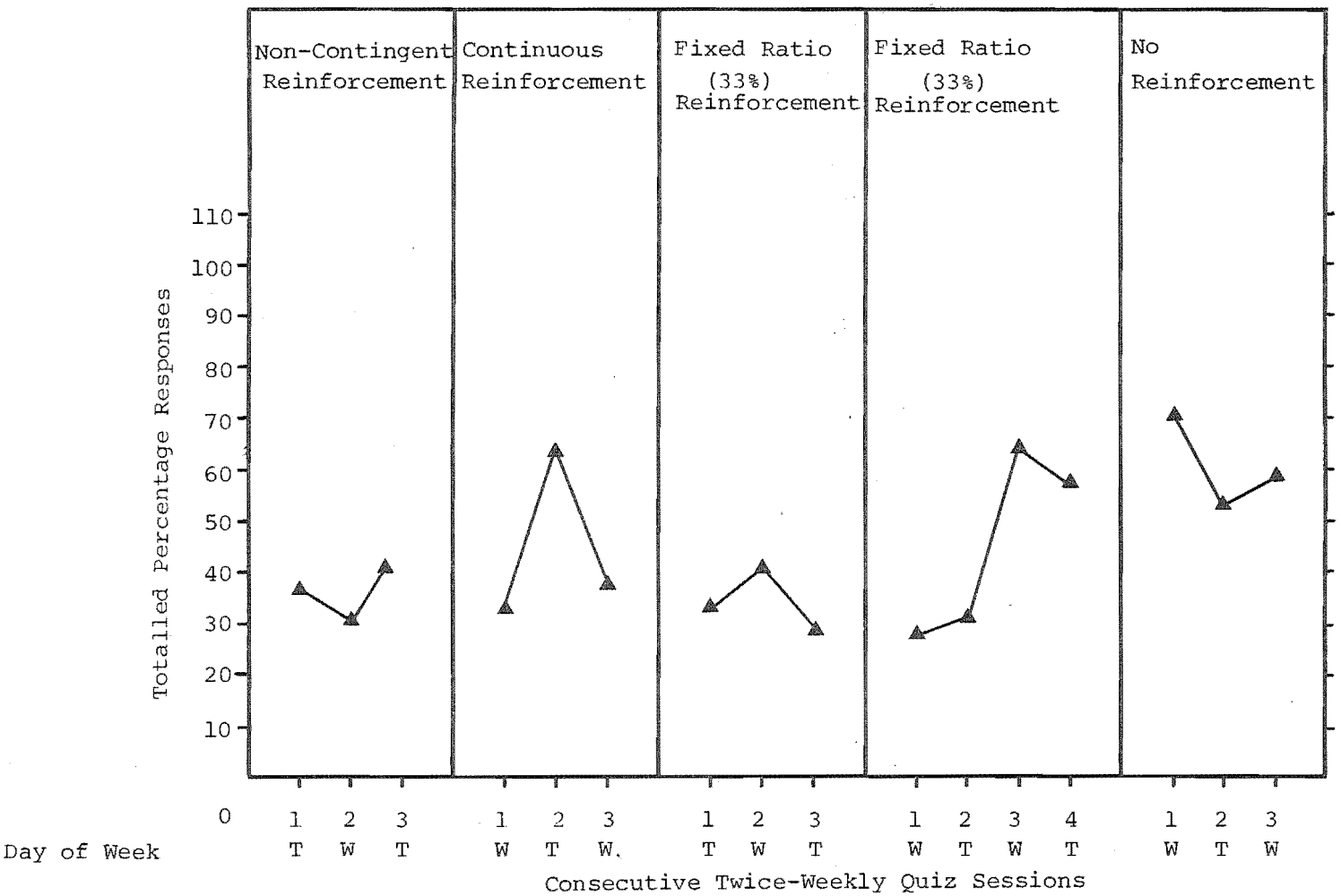


Figure 6. Verbal Responses of 7 Patients (Group III) to Continuous and Fixed Ratio Token Reinforcement.

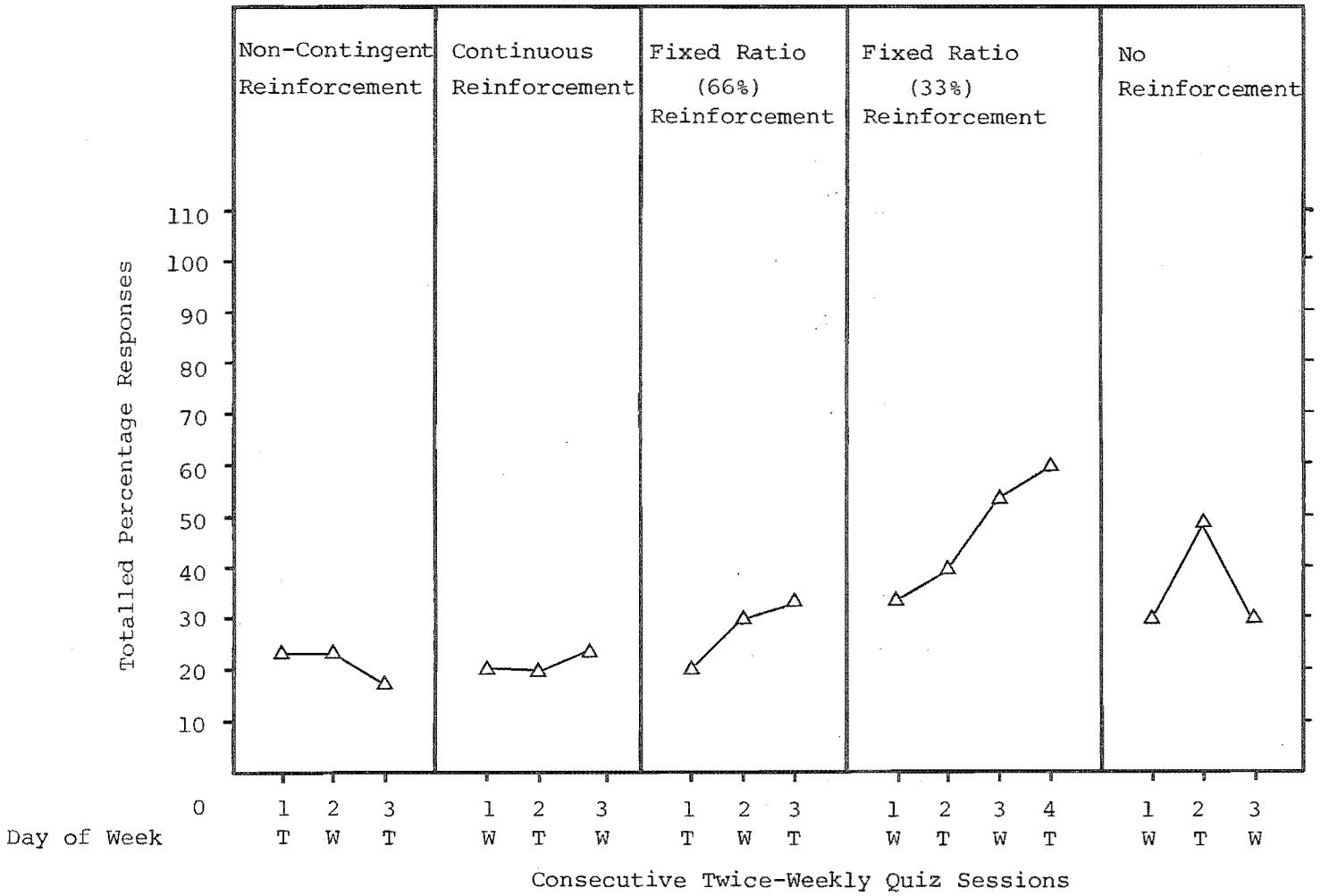


Figure 7. Verbal Responses of 5 Patients (Group IV) to Continuous and Fixed Ratio Token Reinforcement.

One Way Analysis of Variance for Verbal Responses of 26 Patients in Four Groups to Non-Contingent Reinforcement.

Source	SS	df	MS	F
Between Groups	610.82	3	203.61	0.098*
Exptl. Error	45773.06	22	2080.59	
Total	46383.88	25		

*$F_{.99}$ (3,22) = 4.82

Homogeneity: F_{max} = 2.135 $F_{max.99}$ (k=4, df=7) = 14.5

Table 10

One Way Analysis of Variance for Verbal Responses of 26 Patients in Four Groups to Continuous Token Reinforcement.

Source	SS	df	MS	F
Between Groups	718.38	3	239.46	0.2134*
Exptl. Error	24,686.71	22	1,122.12	
Total	25,405.09	25		

$F^*_{.99}$ (3,22) = 4.82

Homogeneity: F_{max} = 2.567 $F_{max\ .99}$ (k=4, df=7) = 14.5

Table 11

One Way Analysis of Variance for Verbal Responses of 26 Patients in Four Groups to No Reinforcement (Extinction).

Source	SS	df	MS	F
Between Groups	2,772.07	3	924.02	0.198*
Exptl. Error	102,476.67	22	4,658.03	
Total	105,248.74	25		

Homogeneity F_{max}= 2.08

*$F_{.99}$ (3,22) = 4.82

$F_{max.99}$ (k=4, df=7) = 14.5

Table 12

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Inter-Observer Reliabilities for Experiment III

Group	Median Reliability	Range	No. of Sessions	Percentage of Sessions
I	94%	80 - 100%	14	87.5%
II	97.5%	88.7 - 100%	16	100%
III	95.6%	93.6 - 100%	15	93.75%
IV	94.6%	82 - 100%	14	87.5%

Table 13

5.3 Results

Inter-observer reliabilities were calculated in the same way as for Experiment II: the median percentage for all groups was in the mid nineties (see Table 13 for details).

Only 26 of the patients on the Ward participated in the quiz sessions (see 5.2, Method, Subjects for details and Appendix E for the raw data). For display purposes only the responses were converted to percentages for each subject and then totalled for each group for the sixteen sessions in the same manner as for Experiment I and Experiment II. The totals were graphed separately for each group and are presented as follows:

Figure 4, Verbal responses of Group I

Figure 5, Verbal responses of Group II

Figure 6, Verbal responses of Group III

Figure 7, Verbal responses of Group IV

For the sake of clarity the responses of the four groups were graphed separately rather than presented together on the same figure. Inspection of the above four figures shows no significant change across treatment conditions for any of the groups.

An assumption made in the experimental design was that the four groups would be equivalent in terms of their response capability. This in fact proved to be the case in phase 1 (baseline with non-contingent reinforcement)

and phase 2 (continuous token reinforcement) as may be seen in Table 10 and Table 11 respectively. In each case a one-way analysis of variance (ANOVA) of the data does not contradict the null hypothesis of no difference between the groups in responding. It was necessary first, however, to establish that a parametric analysis of the data was in order: Table 10 and Table 11 show that in each case the variance was not heterogeneous, i.e., the hypothesis of homogeneity of variance with unequal sample sizes was not contradicted (Winer, 1962). Similarly, for phase 5, (extinction), as may be seen in Table 12, homogeneity of variance was established and there was no significant difference between the groups in their level of verbal responses, i.e., the expected differences in resistance to extinction among the groups was not found.

Strictly the use of an ANOVA with the data recorded in phase 1 (baseline) and phase 2 (continuous token reinforcement) is not legitimate as within each of these two phases there was no difference in treatments between the groups. However, post hoc, because there is no difference between the groups within phase 5 (extinction) it was hypothesised that unprogrammed reinforcement was operating, probably social reinforcement within the group. Therefore, presumably this was operating during phase 1 (baseline) particularly as by inspection of Figure 4, Figure 5, Figure 6 and Figure 7 there is no difference between phase 1 (baseline) and phase 5 (extinction) for any

of the groups despite their different histories of reinforcement. Perhaps the effect of token reinforcement demonstrated in Experiment I and Experiment II was overcome in Experiment III by social reinforcement. Even if this is true, it is not clear whether it holds for all groups equally or whether in respect to social reinforcement Group I is atypical. Certainly, on the basis of Experiment I and Experiment II extinction in phase 5 for Group I with a constant history of continuous token reinforcement was confidently expected .

5.4 Discussion

The results of this study present something of a puzzle. If Experiment I and Experiment II had not been conducted and the results of Experiment III were as found here it could be concluded that token reinforcement regardless of the schedule had no effect on the level of responding of the patients. Response levels remained relatively constant regardless of whether the contingencies were non-contingent reinforcement, continuous token reinforcement, fixed ratio token reinforcement or no reinforcement. This may be stated as it was also established that the groups could be equated in terms of their response capability. But the results of Experiment I and Experiment II show that verbal behaviour change did occur in this population of long-stay psychiatric patients as a function of token reinforcement delivered on a CRF

schedule. In addition, it was shown in Experiment II that non-contingent reinforcement had a positive effect on the level of verbal responding of the patients being studied.

It was predicted that resistance to extinction would be shown inversely in relation to the amount of preceding reinforcement. In fact, all groups showed equal resistance to extinction, irrespective of their token reinforcement history. It is therefore likely that in phase 5 (extinction) anyway, other contingencies of reinforcement were operating to maintain the verbal behaviour of the patients. It could be as mentioned above that this applied only to Group I. There is no way of determining from this study whether in fact this was the case. What may be stated is that the effect of fixed ratio schedules of token reinforcement on the verbal behaviour of the patients was not established as being different from the effect of continuous token reinforcement. There was also no sign of ratio strain.

EXPERIMENT IV: THE EFFECT OF VARIABLE RATIO SCHEDULES OF TOKEN REINFORCEMENT ON VERBAL BEHAVIOUR

6.1 Introduction

The results of Experiment III which was designed to test the effect of fixed ratio schedules of token reinforcement on the verbal behaviour of long-stay psychiatric patients were inconclusive and puzzling. The behaviour showed resistance to extinction following continuous reinforcement as well as that following fixed ratio reinforcement. Resistance to extinction following token reinforcement administered on a CRF schedule is in marked contrast to the behaviour shown by the patients in Experiment I and Experiment II. However, in Experiment III the patients were in four small groups for the quiz sessions rather than in one large group as they had been for the first two studies. It was postulated that unprogrammed reinforcement, most likely social reinforcement, was responsible for maintaining the behaviour during extinction. What was not clear was whether this reinforcement was operating for all groups or only for Group I, which was the only one to have no experience of fixed ratio reinforcement.

This study, Experiment IV, was designed to test the effect of variable ratio schedules of token reinforcement on verbal behaviour in a way that held social reinforcement constant by treating all groups with the same schedules

balanced for order effect. The design would show whether the behaviour of Group I was atypical and if not then differing response rates to different VR schedules of token reinforcement should occur.

It is clear from research with animals (Ferster and Skinner, 1957) that behaviour maintained on VR schedules of reinforcement shows much greater resistance to extinction than does behaviour maintained on a CRF schedule. Characteristically behaviour following VR reinforcement is even more resistant to extinction than behaviour following FR reinforcement. Clinically the power of variable ratio reinforcement in controlling human behaviour is demonstrated in the life histories of habitual gamblers, but as may be seen from Chapter 2 above it is not clearly supported from work with humans using schedules of token reinforcement (see Section 2.6) or more particularly, when the research is on the token reinforcement of verbal behaviour (see Section 2.8.). Furthermore in no studies have the effects of differing variable ratios on the target behaviour been systematically examined. The aim of the present study is to do that with regard to verbal behaviour of the type studied in Experiment I, Experiment II and Experiment III. It was hypothesised that:

1. The rate of verbal responding would be higher when maintained with variable ratio schedules of token reinforcement than with continuous token reinforcement.

2. The rate of verbal responding would be inversely related to the ratio of token reinforcement.

3. The rate of verbal responding in extinction would remain high following variable ratio reinforcement.

6.2 Method

Subjects

The 37 patients on the Ward were the target population and they were the same individuals who resided on the Ward during Experiment III. Details of all the 37 patients in the target population are given in Appendix B with respect to age, years of hospitalisation, diagnosis and type of maintenance medication.

It was possible for all 37 patients to participate in this study but data were analysed on 25 patients only: of the remainder, one preferred to work at a job off the Ward, and eleven more made fewer than a total of 3 responses each during the period of the study. These eleven non-responders included the nine who were non-responders during Experiment III and of these patients, five in particular frequently did not attend the quiz sessions. During the six months of data collecting (24 July 1973 to 23 January 1974) only one patient (D,CV) was transferred from the Ward but he was able still to attend the weekly quiz sessions. Two new patients were transferred to the Ward during the time of the experiment but they were not included in the

study as it was important that the groups in this experiment had the same membership as the groups in Experiment III. (Details of the responding of all patients are given in Appendix F). In this study the population of the ward was divided into four groups (i.e., one group of ten and three groups of nine respectively).

Design

This study followed on directly from the previous experiment and, as mentioned above, it was conducted in the months of July 1973 through to January 1974.
As mentioned above, the patients were divided into four groups, with ten patients in Group I and nine patients each in Groups II, III and IV, with the composition of each group being the same as for Experiment III. Each group was matched for high, low and non-responders.
A quiz session was held for each group once a week for half an hour for a period of 26 weeks, i.e., there was a total of 26 sessions for each group. As in Experiment III, sessions were held each Tuesday and Wednesday morning between 10.30 a.m. and 11.45 a.m.: consecutive sessions for two of the groups were held between 10.30 and 11.00 and between 11.15 and 11.45 a.m. on the two days. The allocation of groups to particular time periods is detailed in Table 15. The design included three phases, namely continuous token reinforcement, variable ratio token reinforcement and non-contingent reinforcement (extinction) in

EXPERIMENTAL DESIGN FOR EXPERIMENT IV WITH VARIABLE RATIO TOKEN REINFORCEMENT

	Phases					
	1			2		3
Schedules	Continuous Reinforcement			Variable Ratio Reinforcement		Non-Contingent Reinforcement
Sessions	1-4	5-8	9-12	13-16	17-20	21-26
Group I	100%	80%	20%	66%	33%	NCR
Group II	100%	20%	80%	33%	66%	NCR
Group III	100%	33%	66%	20%	80%	NCR
Group IV	100%	66%	33%	80%	20%	NCR

Table 14

that order. (The experimental design is outlined in Table 14.) In Experiment II contingencies took effect and behaviour stabilised within blocks of three sessions. However, this was not clearly so in Experiment III. In this study the number of sessions per schedule of reinforcement was increased to four; and in order to test more adequately for resistance to extinction the number of sessions in phase 3 (extinction) was doubled. Furthermore, not only were there twice as many sessions in this final phase but the period covered was four times as long, with one and a half weeks in Experiment III and six weeks in Experiment IV. There was a difference between the periods of extinction in Experiment III and Experiment IV in that in the present study non-contingent reinforcement was used rather than no reinforcement on ethical grounds. It seemed unjustifiable to withold all reinforcement from the patients during this period and in Experiment II the relative effectiveness of continuous reinforcement and non-contingent reinforcement were clearly demonstrated.

In phase 1 there were four sessions of 100% contingent reinforcement, i.e., tokens were dispensed by the quizmaster on a CRF schedule for each new response. This phase was included in the design to establish a base rate of responding before the four groups were reinforced with differing variable ratio schedules of token reinforcement. Also, it was expected that there would be a statistically

ALLOCATION OF GROUPS I, II, III AND IV IN EXPERIMENT IV

TO QUIZ SESSION TIMES

Phase 1. Continuous Token Reinforcement

Session	Day	Time 10.30a.m.-11.00a.m.	11.15a.m.-11.45a.m.	Session	Day	Time 10.30a.m.-11.00a.m.	11.15a.m.-11.45a.m.
1	Tues	II (100%)	IV (100%)	4	Tues	II	IV
	Wed	I (100%)	III(100%)		Wed	I	III
2	Tues	II	IV	5	Tues	II	IV
	Wed	I	III		Wed	I	III
3	Tues	II	IV	6	Tues	II	IV
	Wed	I	III		Wed	I	III

Table 15

Allocation of Groups I, II, III and IV in Experiment IV to Quiz Session Times, ctd.

Phase 2. Variable Ratio Token Reinforcement

Session	Day	Time 10.30a.m.-11.00a.m.	Time 11.15a.m.-11.45a.m.	Session	Day	Time 10.30a.m.-11.00a.m.	Time 11.15a.m.-11.45a.m.
5	Tues	I (80%)	IV (66%)	13	Tues	II (33%)	III (20%)
	Wed	III(33%)	II (20%)		Wed	IV (80%)	I (66%)
6	Tues	IV	III	14	Tues	II	IV
	Wed	II	I		Wed	III	I
7	Tues	IV	III	15	Tues	IV	I
	Wed	II	I		Wed	II	III
8	Tues	II	III	16	Tues	I	II
	Wed	I	IV		Wed	III	IV
9	Tues	IV (33%)	II (80%)	17	Tues	II (66%)	IV (20%)
	Wed	I (20%)	III (66%)		Wed	I (33%)	III (80%)
10	Tues	IV	II	18	Tues	I	II
	Wed	III	I		Wed	III	IV
11	Tues	I	IV	19	Tues	III	IV
	Wed	II	III		Wed	II	I
12	Tues	II	III	20	Tues	III	II
	Wed	IV	I		Wed	I	IV

Table 15 ctd.

Allocation of Groups I, II, III and IV in Experiment IV to Quiz Session Times, ctd.

Phase 3. Non-Contingent Reinforcement

Session	Day	Time	
		10.30a.m.-11.00a.m.	11.15a.m.-11.45a.m.
21	Tues	III (NCR)	IV (NCR)
	Wed	I (NCR)	II (NCR)
22	Tues	I	IV
	Wed	II	III
23	Tues	IV	I
	Wed	II	III
24	Tues	II	I
	Wed	IV	III
25	Tues	II	IV
	Wed	I	III
26	Tues	IV	III
	Wed	I	II

Table 15, ctd

non-significant difference between the groups in this first phase, indicating that the groups were evenly matched with regard to response rate.

In phase 2 variable ratio token reinforcement was introduced with each group experiencing four thirty minute sessions of four conditions of reinforcement, i.e., of 80%, 66%, 33%, and 20% VR reinforcement. This is in contrast to Experiment III where ratio token reinforcement was dispensed on FR 66% and 33% FR schedules. In this phase the order in which groups were allocated to quiz session times (i.e., whether Tuesday or Wednesday morning and whether first or second on either morning) was randomly determined to preclude position effect (see Table 15). There was only one quizmaster throughout this experiment and it was possible that an unprogrammed pattern in his behaviour could develop between 10.30 on a Tuesday morning and 11.45 on a Wednesday morning. In addition, the possibility of order effect influencing the response rate to the different schedules of VR reinforcement was controlled for by the use of a Latin Square. Thus the order in which each group experienced the four treatment conditions of variable ratio token reinforcement was arranged with each condition appearing no more than once in either row or column (see Table 14).

In phase 3, the final phase of the experiment, six sessions were held for each group. The order in which groups were allocated is shown in Table 15.

Procedure

Each Tuesday and Wednesday morning it was announced at the Ward Discussion Meeting by the Charge Nurse that there would be quiz sessions for two groups that morning starting at 10.30 and 11.15 which would last for half an hour. He also drew attention to a notice which had been placed on the day room notice board in advance to let the patients know on what mornings each week their quiz was to take place, and whether their group was first or second in order for that day. (See Table 15).

The quiz sessions were held in the ward day room with the same arrangement as in Experiment III with the exception that only one group was held at a time.

The questions were of an open-ended type allowing for multiple answers; in this respect the stimulus conditions were similar to Experiment I and Experiment III with the exception that a correct answer was any new word beginning with the stipulated letter of the alphabet. By not restricting the letter to any one topic the possible number of responses which any patient could emit was greatly increased. It should be noted, however, that the number of possible responses is not the same for each letter of the alphabet (Thorndike and Lorge, 1938), but by employing this type of stimulus question, each subject in each group had an equal opportunity to make a response.

It was possible that this format would favour those patients with higher intelligence or greater educational experience but it is likely that these variables can be discounted as in the previous studies some of the patients classified as mentally retarded were amongst the highest responders.

An acceptable response was defined as: any answer which began with the given stimulus letter, any answer which had not previously been written on the display board, and any answer which was not a neologism (within the experience of the quizmaster).

When there was no response to a particular letter for a period of 30 seconds (as timed by the quizmaster) the quizmaster then asked the group: "Are there any more words beginning with the letter ...?" If there was no response within a 10 second interval following this request, the quizmaster then said: "Well, let's go on to the next letter."

Each session began with a new letter which was different with each group; it was always ensured that the two groups on any one morning began with different stimulus letters. A record was kept for each group of what letters had been used and what remained to be used as stimuli.

When a correct response was made the quizmaster wrote the response on the board and reinforced the respondent with a token and the comment 'good'. Before each session, the

patients were reminded of the value of the tokens in relation to the back-up reinforcement for which they could be exchanged: the exchange ratio was the same as for the previous studies, i.e., four tokens for a cigarette, eight tokens for a small bar of chocolate or two tokens for a small bag of sweets.

The tokens used in this study were the same as those used in the previous three studies, that is they were specially made brown plastic discs of 35mm in diameter and 2mm in thickness. They were dispensed in all phases of the experiment including phase 3, but in this phase they could not be exchanged for back-up reinforcement. In phase 2, modified tokens were included in a pre-determined amount to enable the implementation of variable ratio schedules of token reinforcement. The modification consisted of a 1mm hole being made through the centre of the token. A token that was modified in this way was called a 'super token' as it was the only one exchangeable for back-up reinforcement at the conclusion of the variable ratio sessions. The tokens and super tokens were identical except for this 1mm hole. Prior to phase 2, super tokens and ordinary tokens were mixed to provide the requirements of different schedules of variable ratio reinforcement and placed in separate containers. Specifically, super tokens and tokens were mixed in the ratio of 4:1 for the VR 80% condition; in the ratio of 2:1 for the VR 66% condition; in the ratio 1:2 for the VR 33% condition; and in the ratio

1:4 for the VR 20% condition.

The procedure with the use of tokens and super tokens ensured that the interaction between the quizmaster and the respondents was constant across all conditions and it did not involve any cues being given to the quizmaster by the recorder as was the case in Experiment III. When super tokens were being used the quizmaster could not distinguish them from ordinary tokens by touch and it was only after a token was received by a respondent from the quizmaster could he tell whether the token was a super token or an ordinary token.

In the 16 weeks of phase 2, therefore, the ordinary token lost its value as a reinforcer. It continued to have no value in phase 3, which was appropriate as this was an extinction condition. But, as already mentioned, by continuing to dispense tokens the quizmaster was maintaining a standard pattern of interaction with members of each group.

Patients were not allowed to retain tokens from one session to another; all tokens were exchanged at the end of each session. This was checked by comparing the number of responses recorded by the observer with the number of tokens each patient handed in.

At the beginning of each phase the quizmaster gave different instructions as appropriate. Prior to the first phase of continuous token reinforcement, he explained

to the subjects that by participating in the quiz sessions and giving relevant answers they could earn tokens which would be exchangeable at the end of each sessions for cigarettes, chocolate and sweets, on the same basis as earlier sessions. What constituted a relevant answer was the same as for Experiment III, the only difference being that responses to designated letters were not restricted to any one topic.

In phase 2 of the experiment the introduction of the four VR schedules was made with the following instructions which were given to each group in turn:

> "This morning we carry on as usual, but from now on we will have a mixture of super tokens and ordinary tokens, the super tokens being those with holes pierced through the centre of the token. From now on it is only the super tokens which can be exchanged for cigarettes and chocolate, which are the same price as before. The ordinary tokens have no value. We might call this a lucky dip system, just to add a bit of variety to what we have been doing so far. Do you all understand this new procedure?"

These instructions were repeated in paraphrased form at the beginning of each session.

In phase 3, before the introduction of non-contingent reinforcement, the following instructions were given:

> "This morning there will be a change in the proceedings. At the end of the session each person present will receive either four cigarettes or two bars of chocolate. Ordinary tokens will be given out as usual but they will have no value. They will just show you how many words you have thought of. Do you all understand this new procedure?"

This instruction also was repeated in paraphrased form at the beginning of each session. To answer any queries about the tokens with the holes used in the previous phase, the standard reply was: "The super tokens are being counted up at present and so we cannot use them".

An attempt was made by the quizmaster to keep instructions as neutral as possible with regard to imparting information to patients about the various reinforcement contingencies. The confounding effects of instructions on performance is well known: Agras, Leitenberg, Wincze, Butz and Callahan (1970); Ayllon and Azrin (1964); Ayllon, Simon and Wildman (1975); Baron, Kaufman and Stauber (1969); Bassett, Blanchard and Koshland (1975); Evans and Spradlin (1966); Frazier (1973); Herman and Tramontana (1971); Kazdin (1971a, 1971b, 1973b); Masters and Blanch (1969); Meichenbaum (1969); Skinner (1963); Suchotliff, Greaves, Stecker and Berke (1970); Winkler (1969); Zimmerman, Zimmerman and Russell (1969).

Two recorders were present during the first five weeks of this study.As in Experiment III they sat at opposite ends of the semi-circle of patients. Inter-observer reliability was calculated by dividing the number of agreements on responses emitted by the patients, by the number of agreements plus disagreements in the same way as in Experiment II and Experiment III. In phase 1 of this study reliability coefficients ranged from 95.3% to 100%,

with an average of 98.3%.

Because the reliability figures were high and the observers were experienced, reliability checks were taken only intermittently during phase 2 and phase 3. Two recorders were present for 22% of the sessions in these phases and agreement ranged from 92.2% to 100%, with an average of 98%.

A separate reliability check was available when only one observer (the author) was present as the number of responses recorded could be compared with the number of tokens collected by each patient at the end of every session and tokens were dispensed in all sessions.

6.3 Results

Inter-observer reliability was in the high nineties: details are given at the end of the previous section (see 6.2, Method).

25 of the patients on the ward participated in the quiz session, as specified above (see 6.2, Method: Subjects, for details, and Appendix E for the raw data). All were patients who made responses in Experiment III.

This study was designed to test the effect of variable ratio schedules of token reinforcement on the verbal responding of long-stay psychiatric patients. But before the effect of the schedules themselves was examined, it was necessary to determine that the groups being studied were behaving consistently, as it was not clear from Experiment III whether or not Group I was behaving atypically. Therefore, analyses were carried out on the behaviour of the four groups in each of the conditions of reinforcement.

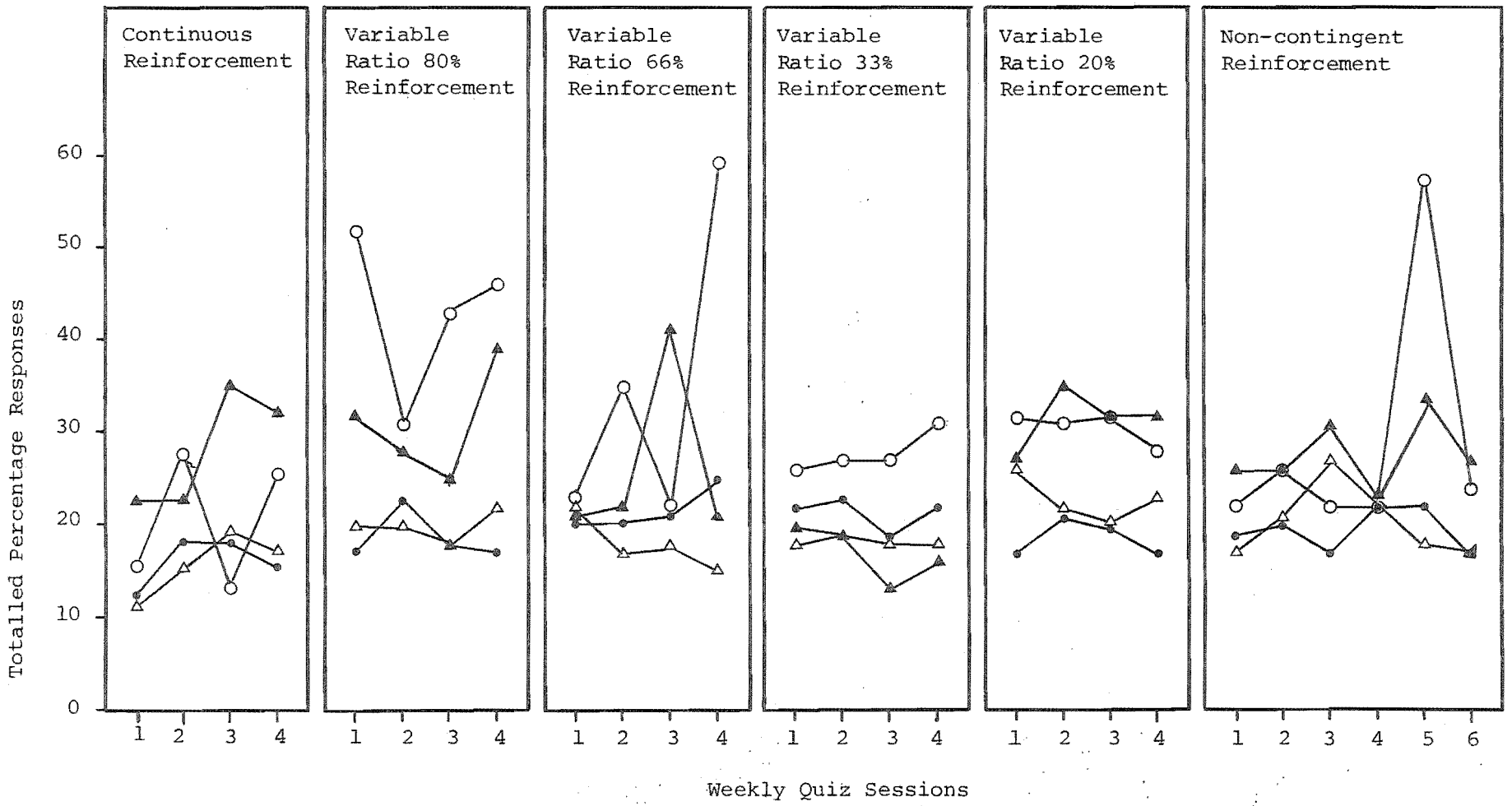

Figure 8. Verbal Responses of 25 Patients in Four Groups to differing Schedules of Token Reinforcement. (Continuous, Variable Ratio and Non-Contingent)

One Way Analysis of Variance for Verbal Responses of 25 Patients in Four Groups to Continuous Token Reinforcement.

Source	SS	df	MS	F
Between Groups	12,427.96	3	4,142.65	0.633*
Exptl. Error	137,375.00	21	6,541.67	
Total	149,802.96	24		

*$F_{.99}$ (3,21) = 4.87

Homogeneity: F_{max} = 14.39 $F_{max.99}$ (k=4, df=7) = 14.5

Table 16

Kruskal-Wallis One-Way Analysis of Variance by Ranks for Verbal Responses of 25 Patients in Four Groups to Continuous Token Reinforcement.

	Sums of Ranks				df	H	p.
Groups	I	II	III	IV			
	91	91	86	57	3	3.36	>.3

Table 17

One Way Analysis of Variance for Verbal Responses of 25 Patients in Four Groups to 80% Variable Ratio Token Reinforcement.

Source	SS	df	MS	F
Between Groups	25,018.47	3	8,339.49	1.239*
Exptl. Error	141,318.47	21	6,729.45	
Total	166,336.94	24		

*$F_{.99}$ (3,21) = 4.87

Homogeneity: F_{max} = 8.35

$F_{max.99}$ (k=4, df=7) = 14.5

Table 18

One Way Analysis of Variance for Verbal Responses of 25 Patients in Four Groups to 66% Variable Ratio Token Reinforcement

Source	SS	df	MS	F
Between Groups	31,315.31	3	10,438.44	1.036*
Exptl. Error	211,554.73	21	10,074.03	
Total	242,870.04	24		

*$F_{.99}(3,21) = 4.87$

Homogeneity: $F_{max} = 8.35$ $F_{max.99}(k=4, df=7) = 14.5$

Table 19

One Way Analysis of Variance for Verbal Responses of 25 Patients in Four Groups to 33% Variable Ratio Token Reinforcement.

Source	SS	df	MS	F
Between Groups	31,950.48	3	10,650.16	1.070*
Exptl. Error	209,105.26	21	9.957.39	
Total	241,055.74	24		

*$F_{.99}(3,21) = 4.87$

Homogeneity: $F_{max} = 7.70$

$F_{max.99}$ (k=4, df=7) = 14.5

Table 20

One Way Analysis of Variance for Verbal Responses of 25 Patients in Four Groups to 20% Variable Ratio Token Reinforcement

Source	SS	df	MS	F
Between Groups	32,194.97	3	10,731.66	1.650*
Exptl. Error	136,606.90	21	6,505.09	
Total	168,801.87	24		

*$F_{.99}$ (3,21) = 4.87

Homogeneity: F_{max} = 8.62

$F_{max.99}$ (k=4, df=7) = 14.5

Table 21

One Way Analysis of Variance for Verbal Responses of 25 Patients in Four Groups to Non-Contingent Reinforcement

Source	SS	df	MS	F
Between Groups	67,970.69	3	22,656.90	0.946*
Exptl. Error	502,873.57	21	23,946.36	
Total	570,844.26	24		

*$F_{.99}$ (3,21) = 4.87

Homogeneity: F_{max} = 5.38

$F_{max.99}$ (k=4, df=7) = 14.5

Table 22

One Way Analysis of Variance (Repeated Measures) for Verbal Responses of 25 Patients to Differing Schedules of Token Reinforcement, (Continuous, Variable Ratio and Non-Contingent).

Source	SS	df	MS	F
Between Patients	1,102,389.89	24	45,932.91	
Within Patients	136,572.76	125	1,092.58	
Between Schedules	13,841.21	5	2,768.24	2.71*
Exptl. Error	122,731.55	120	1,022.76	
Total	1,238,962.65	149		

*$F_{.95}$ (5,120) = 2.29

$F_{.99}$ (5,120) = 3.17

Table 23

Differences between Pairs of Mean Verbal Responses of 25 Patients to Differing Schedules of Token Reinforcement (Continuous, Variable Ratio, and Non-Contingent) Tested by the Newman-Keuls Method for Repeated Measures.

Schedules		CRF	VR80%	VR20%	NCR	VR33%	VR66%
	Totals	2436.50	2929.50	3001.01	3067.63	3100.50	3157.00
CRF	2436.50	-	493.00*	564.51*	631.13*	664.00*	720.50*
VR80%	2929.50		-	71.51	138.13	171.00	227.50
VR20%	3001.01			-	66.62	99.49	155.99
NCR	3067.63				-	32.87	89.37
VR33%	3100.50					-	56.50
VR66%	3157.00						-

$\sqrt{n^{MS}_{res}} = 159.9$ *p<.05

	$q_{.95}(r,120)$	2.80	3.36	3.69	3.92	4.10
$\sqrt{n^{MS}_{res}}$	$q_{.95}(r,120)$	447.72	537.26	590.03	626.80	655.59
	$q_{.99}(r,120)$	3.70	4.20	4.50	4.71	4.87
$\sqrt{n^{MS}_{res}}$	$q_{.99}(r,120)$	591.63	671.58	719.55	753.12	778.70

Table 24

For display purposes only the responses were converted to percentages for each subject and then totalled for each group for each of the 26 sessions (see Figure 8) in the same manner as for Experiments I, II and III. The group results were graphed to provide comparisons for each condition of reinforcement: phase 1 (CRF schedule) and phase 3 (NCR schedule) results are in consecutive order and the results of phase 2 (VR schedules) are in consecutive order within each schedule for the separate groups. But within phase 2 the order between schedules has been re-arranged with the schedules presented in decreasing magnitude of VR token reinforcement.

Table 16 shows that there was no significant difference between Group I, Group II, Group III or Group IV with regard to verbal responses made to continuous token reinforcement. The data were analysed by means of a one-way analysis of variance for unequal sample sizes but the null hypothesis with regard to homogeneity of variance was not supported and so a non-parametric analysis was made. However, the Kruskal-Wallis one-way analysis of variance by ranks also failed to show a significant difference between the groups with regard to verbal responses to continuous

token reinforcement, i.e., this supported the results of the questionable parametric analysis that was first conducted. (See Table 17).

Table 18 shows the results of a one-way analysis of variance for unequal sample sizes for the verbal responding of the four groups of patients to VR 80% token reinforcement. The result is not significant and the criterion of homogeneity of variance was met.

Table 19 shows the results of a one-way analysis of variance with unequal sample sizes for the verbal responses of the four groups of patients to VR 66% token reinforcement. The result is not significant and the criterion of homogeneity of variance was met.

Table 20 shows the results of a one-way analysis of variance for unequal sample sizes for the verbal responses of the four groups of patients to VR 33% token reinforcement. The result is not significant and the criterion of homogeneity of variance was met.

Table 21 shows the results of a one-way analysis of variance for unequal sample sizes for the verbal responses of the four groups of patients to VR 20% token reinforcement. The result is not significant and the criterion of homogeneity of variance was met.

Table 22 shows the results of a one-way analysis of variance for unequal sample sizes for verbal responses of the four groups of patients to non-contingent reinforcement.

The result is not significant and the criterion of homogeneity of variance was met.

Thus there was no difference between Groups I, II, III and IV in their responding irrespective of the type of schedule of reinforcement, i.e., the results could be treated as though they were repeated measures (4) on the same subjects. As there were no differences between the groups it was possible to test for differences between schedules ignoring groups as neither Group I nor any other group was atypical, and the results with regard to phase 2 (i.e., VR schedules) were balanced for order effect.

Table 23 shows the results of a one-way analysis of variance (repeated measures) for verbal responses of 25 patients to the differing schedules of token reinforcement (continuous, variable ratio, and non-contingent). The results are significant ($p < .05$). These results were then tested by the Newman-Keuls method for repeated measures to discover where the significant differences lay. As Table 24 shows all schedules of VR token reinforcement together with the condition of non-contingent reinforcement significantly differ from continuous token reinforcement but they do not otherwise differ between themselves. In effect, this analysis supports hypothesis 1 and hypothesis 3, but does not support hypothesis 2.

The results show that variable ratio schedules of token reinforcement generate higher levels of responding than continuous reinforcement. In addition, not only is resistance to extinction demonstrated but the rate of responding during extinction was in fact higher than in the initial period of continuous reinforcement.

6.4 Discussion

The aim of this study was to test the effect of variable ratio schedules of token reinforcement on the verbal behaviour of long-stay psychiatric patients. The first hypothesis was supported, namely that variable ratio schedules of token reinforcement would generate higher rates of responding than a continuous reinforcement schedule. The second hypothesis, however, was not supported: the differing ratio schedules did not produce differences in the rate of responding as expected. It was predicted that the rate of responding would be inversely related to the size of the schedule but this was not the case. A number of reasons may be suggested as to why this happened:

First, the size of the groups was relatively small, especially when the actual numbers responding in each are considered. In Group I only five patients out of ten responded; in Group II eight patients out of nine responded; in Group III seven patients out of nine responded; and in Group IV only five patients out of nine

responded. It was likely that a high degree of variability in response rate within each group would be produced. This in fact happened as there were high, low, and non-responders in each group and this was the same for each group.

Second, the subjects had a long history of varied token reinforcement and it could have been the effect of this which maintained the level of responses at a high rate through both phases 2 and 3.

Third, it could be that four sessions each with the different amounts of variable ratio token reinforcement were insufficient for the patients to make a discrimination between the schedules.

The third hypothesis was supported, i.e., that resistance to extinction would be shown following variable ratio schedules of token reinforcement. This resistance to extinction may, however, have been the result in part anyway of unprogrammed reinforcement. It is likely that social reinforcement played a part in maintaining the attendance of some of the non-responders at the group sessions over several months; it also appeared to affect the behaviour of the high responders who interacted in a way that did not occur before Experiment I started. It could be that Experiment I and Experiment II were effective in 'priming the pump of social interaction' and that subsequently the patients found the social nature

of the token reinforcement sessions intrinsically reinforcing. It could also be that the social activity of the token sessions was a highlight of the week, regardless of how much back-up reinforcement could be earned with tokens. Barton (1972), for instance found that tokens were more reinforcing than candy even when they were used to purchase the same sort of candy as was used as a primary reinforcer. Barton's study was with retardates but also with 'normals', Weiner (1972) found that subjects responded at a higher rate to a fixed ratio schedule on a button-pressing task with tokens plus money back-up than with tokens plus a larger amount of non-contingent money.

Few studies have attempted to assess the separate contribution of social reinforcement operating in a token system and as Ribes-Ineste, Duran, Evans, Felix, Rivera and Sanchez (1973, p.128) comment: "the importance of tokens may be related not to the control of the individual who receives them as reinforcers, but to the scheduling of the behaviour of those who provide social reinforcement in the framework of a token system".

To conclude: clinically the study was a success in that a high rate of verbal responding in previously unresponsive patients was both maintained and increased. Experimentally, two of the three hypotheses were supported but it is likely that unprogrammed reinforcement as well as the scheduled token reinforcement was affecting the behaviour of the patients.

CHAPTER 7

DISCUSSION AND CONCLUSIONS

The four experiments reported in this thesis provided some expected and some unexpected results. The main unexpected result was resistance to extinction following continuous token reinforcement in Experiment III. However, a similar phenomenon has been reported in unpublished work by Winkler (1969, p.262): "The failure to find deterioration in the group of behaviours not given partial reinforcement is inconsistent with the previous work reported in this thesis and with Ayllon and Azrin (1965)". (The behaviours referred to were self-care behaviours). He also reports an unpublished study by Sheppard and Winkler (1969)(but gives no data) of a classroom token system in which although no partial reinforcement was given prior to extinction the children's behaviour did not deteriorate markedly during the three weeks of non-reinforcement. He also reports that Ingham, Andrews and Winkler (1969) found that stutterers maintained their gains after leaving a token system even though they had not received partial reinforcement. Presumably unprogrammed reinforcement is operating in each case.

In the present thesis the unprogrammed reinforcement is likely to have been the social reinforcement provided by the quiz sessions once responding had been established with the use of token reinforcement. This social reinforcement would also have tended to mask the effect of ratio size on both response rate and resistance to extinction. In order to test this, subjects could be tested on their own in a manner similar to studies carried out by Weiner,

but even here unexpected results have been reported, e.g., Weiner (1972) found higher response rates on a button pressing task with tokens (points) dispensed on an FR schedule with money back-up than tokens with non-contingent money, even when the amount of money dispensed non-contingently was the greater.

It is not clear what the contribution of unprogrammed reinforcement was to the results of Experiment III and Experiment IV, but it is clear that clinically the studies were a success. The results of the four studies cannot be compared precisely as the nature of the stimulus conditions was different in each experiment and the length of time per session was one hour in Experiments I and II as compared with half an hour in Experiments III and IV. However, if the stimulus conditions are regarded as similar and response rates are adjusted as for half hour sessions the response rate during the extinction period of Experiment IV was ten times greater than for the baseline period of Experiment I and five times greater than for the final session of continuous token reinforcement of Experiment I.

Finally, in the studies reported in this thesis, the verbal behaviour of long-stay psychiatric patients was dramatically changed by token reinforcement but the effect of differing ratio schedules was not demonstrated.

APPENDIX A

THE OPERANT CONDITIONING OF VERBAL BEHAVIOUR

A.1. Theoretical Considerations

The controversy which followed Skinner's publication of Verbal Behavior (1957) is reminiscent of the debate at Oxford in the 1890s after Darwin had published Origin of the Species (1890). On that occasion Bishop Wilberforce's argument supporting the 'special creation' position was demolished by Thomas Huxley who defended Darwin's views. In the modern parallel Chomsky (1959) adopts a 'special creation' view of verbal behaviour and MacCorquodale (1970) defends Skinner's position. But at that point the comparison breaks down for as Skinner himself sees no need, apparently, to refute Chomsky, Chomsky and his followers consider they have won the debate, and MacCorquodale has been ignored. Greene (1972) seeks to clarify Chomsky's views and Chomsky (1973) himself is critical of Skinner's more general position as expressed in Beyond Freedom and Dignity, (Skinner, 1971). This is discussed by Owens, Oxford and MacKrell (1975). However, Skinner (1974) in About Behaviorism, restates the operant position on verbal behaviour and ignores Chomsky and also those like Suppes (1969) who gave Skinner support from an unexpected quarter.

The basis of the difference between Chomsky and Skinner is theoretical; it concerns the acquisition of language and it is not an issue that will be

discussed here. What follows is an examination of the empirical evidence relating to the operant conditioning of verbal behaviour.

A.2. Empirical Findings

The experimental control of verbal behaviour has been reported in a number of studies and books:

Barton (1970)

Brodsky (1967)

Bryan and Kapche (1967)

Buss and Gerjuoy (1958)

Buss, Gerjuoy and Zusman (1958)

Chapman, Chapman and Miller (1964)

Cohen and Cohen (1960)

Cohen, Kalish, Thurston and Cohen (1954)

Copeland (1963)

Das (1970)

Green and Marlatt (1972)

Hanaway and Barlow (1975)

Hartman (1955)

Herman and Tramontana (1971)

Holz and Azrin (1966)

Ince (1968a)

Ince (1968b)

Lane and Shinkman (1963)

MacCorquodale (1970)

Meichenbaum and Cameron (1973)

Meichenbaum and Goodman (1969a)

Meichenbaum and Goodman (1969b)

Meichenbaum and Goodman (1971)

Owens, Oxford and MacKrell (1975)

Peterson (1956)

Premack (1970)

Rattan and Chapman (1973)

Robinson and Lewinsohn (1973a)

Robinson and Lewinsohn (1973b)

Sherman and Baer (1969)

Shearn, Sprague and Rosenzweig (1961)

Spielberger (1965)

Spielberger and De Nike (1966)

Staats (1972)

A further and larger range of studies has been concerned with verbal conditioning in a wider sense, i.e., the modification of essentially normal verbal behaviour in normals, neurotics and psychotics to demonstrate that operant conditioning principles were at work in the modification of verbal behaviour in those who may be considered to have already acquired a verbal repertoire. A major interest has been to see to what extent treatment procedures such as psychotherapy may be understood as verbal conditioning exercises. One particular issue which is still not satisfactorily resolved is the question of awareness in verbal conditioning. Studies of this issue have been reported by:

Adam and Paul (1973)

Dixon and Oakes (1965)

Ells (1967)

Greenspoon and Brownstein ((1967)

Hersen (1968)

Kanfer and McBrearty (1961)

Krasner (1967)

Levin (1961)

Loeber and Weisman (1975)

Mandel and Goodstein (1969)

Mikulas (1970)

Miller (1967)

Miller and Minten (1972)

Oakes (1967)

Oakes (1970)

Rosenfeld and Baer (1969)

Rosenfeld and Baer (1970)

Sidowski (1954)

Simkins (1963)

Spielberger (1962)

There are many other studies where awareness has not been the issue:

Miscellaneous Studies of Verbal Conditioning

Beech and Adler (1963)

Binder, McConnell and Sjoholm (1957)

Carroll, Kossuth and Rogers (1971)

Davison and Kirkwood (1968)

De Nike and Spielberger (1963)

Dinoff, Horner, Kurpiewski and Timmons (1960)

Di Vittis (1965)

Ebner (1965)

Eysenck (1959)

Ferguson and Buss (1960)

Finley and Staats (1967)

Gelder (1968)

Gelfand (1962)

Goodkin (1969)

Grant, Hake and Hornseth (1951)

Greenspoon (1951)

Greenspoon (1956)

Grossberg (1956)

Gupta (1970)

Gupta (1973)

Gutierrez and Eisenman (1971)

Hall (1958)

Hartlage (1970)

Heckel, Wiggins and Salzberg (1962)

Hekmat (1971)

Heller and Marlatt (1969)

Hildrum and Brown (1956)

Hilford (1974)

Johannsen and Campbell (1964)

Johns and Quay (1962)

Kanfer (1954)

Kanfer (1968)

Krasner (1958b)

Krasner (1962)

Krasner (1965)

Krasner, Knowles and Ullmann (1965)

Krasner and Ullmann (1958)

Krasner, Ullmann and Fisher (1964)

Krasner, Ullmann, Weiss and Collins (1961)

Krasner, Weiss and Ullmann (1961)

Lapuc and Harmatz (1970)

Letchworth (1963)

Leventhal (1958)

Lilliston (1972)

Locke (1969a)

Locke (1969b)

McNair (1957)

Mandler (1956)

Marlatt (1970)

Marlatt (1972)

Matarazzo, Saslow and Pareis (1960)

Panek (1966)

Pawlicki, Miller and Haley (1973)

Persons (1968)

Philips and Agnew (1953)

Portnoy and Salzinger (1964)

Postman and Sassenrath (1961)

Quay (1959)

Quay and Hunt (1965)

Rickard, Dignam and Horner (1960)

Rickard and Dinoff (1962)

Robertson (1958)

Robertson (1961)

Rogers (1960)

Salzinger (1969)

Salzinger and Pisoni (1958)

Salzinger, Pisoni and Feldman (1960)

Salzinger and Portnoy (1964)

Salzinger, Portnoy and Feldman (1964)

Salzinger, Salzinger, Portnoy, Eckman, Bacon, Deutsch and Zubin (1962)

Sapolsky (1960)

Scott (1957)

Simkins and West (1966)

Slechta, Gwynn and Peoples (1963)

Somner (1967)

Sullivan and Calvin (1959)

Taffel (1952)

Taffel (1955)

Tobias (1960)

Tracey, Briddell and Wilson (1974)

Truax (1966)

True (1962)

Ullmann (1970)

Ullmann, Forsman, Kenny, McInnis, Unikel and Zeisset (1965)

Ullmann, Krasner and Collins (1961)

Ullmann, Krasner and Edinger (1964)

Verplanck (1955)

Vestre (1965)

Vogler and Ault (1969)

Wall and Campbell (1970)

Weiss, Krasner and Ullmann (1960)

Weiss, Krasner and Ullmann (1963)

Weiss, Ullmann and Krasner (1960)

Williams and Blanton (1968) Wilson and Verplanck (1956)

On the basis of the above studies it may be said that whatever the origins of verbal behaviour it is clear that it may be maintained and modified by operant conditioning principles. The majority of the above studies have as their starting point research carried out initially by Verplanck (1955). Azrin, Holz, Ulrich and Goldiamond (1961) carried out a replication of it which raised the damaging suggestion that perhaps the original study by Verplanck was suspect. The Azrin et al (1961) study has been largely overlooked as the editor of the Journal of Applied Behavior Analysis pointed out when he reprinted it in 1973. The reprint, however, seems to have suffered the same fate. For more detailed reviews of studies on verbal conditioning see Inglis (1966); Kanfer (1958); Krasner (1958a); Salzinger (1959); Stieper, Ells, Farkas and Caplan (1972); and Williams (1964). The most recent review, by Stieper et al (1972) is rightly critical of many of the investigations reported.

They make an important point:

> "There is a difference between defining rewards a priori and empirically establishing them as reinforcing - a distinction rarely observed in this sample of experiments."

(Experiment IIof this thesis is concerned with the establishment of tokens as conditioned reinforcers.)

Studies of the acquisition of speech in non-verbal children by operant conditioning

Ayllon and Kelly (1974)

Baer and Guess (1971)

Barnett, Pryer and Ellis (1959)

Bartlett, Ora, Brown and Butler (1971)

Barton (1972)

Barton (1973)

Borus, Greenfield, Siegel and Daniels (1973)

Bricker and Bricker (1972)

Buddenhagen (1971)

Colligan and Bellamy (1968)

Clark and Sherman (1975)

Cook and Adams (1966)

Drash, Caldwell and Leobowitz (1970)

Frisch and Shumaker (1974)

Garcia (1974)

Garcia, Baer and Firestone (1971)

Garcia, Guess and Byrnes (1973)

Gray and Fygetakis (1968)

Guess (1969)

Guess and Baer (1973a)

Guess and Baer (1973b)

Guess, Rutherford and Twichell (1969)

Guess, Sailor, Rutherford and Baer (1968)

Hall (1970)

Hewett (1965)

Hingten, Bandura and De Meyer (1965)

Hingten, Sanders and De Meyer (1965)

Hingten and Trost (1966)

Jackson and Wallace (1974)

Jacobson, Bernal and Lopez (1973)

Kerr, Meyerson and Michael (1965)

Koegel and Rincover (1974)

Lane (1960)

Lovaas (1961)

Lovaas (1964a)

Lovaas (1964b)

Lovaas (1964c)

Lovaas (1968)

Lovaas, Berberich, Perloff and Schaeffer (1966)

Lovaas, Koegel, Simmons and Long (1973)

Lutzker and Sherman (1974)

MacAulay (1968)

McClure (1968)

MacCubrey (1971)

McReynolds (1970)

McReynolds and Huston (1971)

Martin, England, Kaprowsky, Kilgour and Pilek (1968)

Marshall and Hegrenes (1970)

Picaizen, Berger, Baronofsky, Nichols and Karen (1969)

Rheingold, Gerwitz and Ross (1959)

Risley and Wolf (1967)

Sailor (1971)

Sailor, Guess and Baer (1973)

Salzinger, Feldman, Cowan and Salzinger (1965)

Schell, Stark and Giddan (1967)

Schumacher and Sherman (1970)

Sloane, Johnston and Harris (1968)

Stark, Giddan and Meisel (1968)

Steeves, Martin and Pear (1970)

Stevens-Long and Rasmussen (1974)

Sulzbacher and Costello (1970)

Twardosz and Baer (1973)

Wheeler and Sulzer (1970)

Whitman, Burish and Collins (1972)

Wolf, Risley and Mees (1964)

Reviews of the field of speech acquisition in non-verbal children are provided by Harris (1975) and Hartung (1970). As Harris (1975, p.574) points out under the umbrella term non-verbal are subsumed a number of different populations: "The diagnostic labels include autism, childhood schizophrenia, dysphasia, mental retardation, and brain damage." She also points out that the subjects vary in IQ estimates from "untestable" to normal potential and vary in level of functional speech: some being echolalic, some mute who have never talked, some mute who have talked and others with limited speech. But overall the aim of these studies of children is the

production and maintenance of functional speech. Harris (1975, p.570) gives a good description of typical procedures used:

> Following initial training on a continuous reinforcement schedule, reinforcement is typically shifted to an intermittent schedule ... This shift is critical because maintenance in the natural environment is almost always on an intermittent basis. The importance of using different kinds of reinforcement in different phases of training was suggested by McReynolds (1970), who demonstrated that primary reinforcers were more effective than social reinforcers during the initial phases of learning a verbal behavior but that once the behavior was established, social reinforcement was sufficient to maintain the response.

The use of token systems and intermittent schedules of reinforcement is pertinent to this thesis and the studies using them are discussed above in sections 2.6 and 2.8.It is, however, worth pointing out here that many of the studies using intermittent schedules do so for practical purposes and the rationale behind their use is not given and the relative effectiveness of different types of intermittent schedules is not investigated.

The production of functional speech has been the concern of investigators in another field, that of subjects whose speech is dysfluent. Studies have been carried out in which operant principles have been used in the design of treatment programmes, in the main for stuttering, e.g.,

Alford and Ingham (1969)
Andrews and Ingham (1972)
Bennett (1974)
Brady (1968)

Browning (1967)

Case (1960)

Egolf, Shames and Blind (1971)

Flanagan, Goldiamond and Azrin (1958)

Goldiamond (1965)

Holland (1967)

Ingham (1971)

Ingham and Andrews (1973a)

Ingham and Andrews (1973b)

Ingham, Andrews and Winkler (1972)

Jones and Azrin (1969)

Leach (1969)

Marshall and Watts (1975)

Martin (1968)

Martin and Siegel (1966)

Perkins (1973)

Quist and Martin (1967

Rickard and Mundy (1965)

Rosso (1972)

Russell, Clark and Van Sommers (1968)

Ryan (1971)

Ryan and Van Kirk (1974)

Shames (1969)

Shames (1970)

Shames and Sherrick (1965)

Shaw and Shrum (1972)

Siegel (1970)

Siegel, Lenske and Broen (1969)

Starkweather (1973)

Walton and Black (1958)

Webster (1970)

Wohl (1970)

Wolpe (1969)

Reviews of the field are provided by Ingham and Andrews (1973c), Van Riper (1970) and Yates (1963). And, as with other studies already referred to in this Appendix, those involving the use of either intermittent schedules or tokens are discussed above in sections 2.6 and 2.8

The great bulk of studies dealing with the manipulation of verbal behaviour in the classroom have involved the use of tokens and these are cited in Table 3.

There are also subjects whose disability makes them close to the population sampled in the experiments reported in this thesis, i.e., those who for one reason or another are mute. One group, usually children, are described as being electively mute or as Harris (1975, p.565) puts it, "these subjects have a full repertoire of responses but have difficulty identifying the discriminative stimuli for speech." Studies in this field have been reported by:

Blake and Moss (1967)

Halpern, Hammond and Cohen (1971)

Nolan and Pence (1970)

Reid, Hawkins, Kreutzer, McNeal, Phelps, Reid and Mees (1967)

Shaw (1971)

Sluckin and Jehu (1969)

Van Der Kooy and Webster (1975)

Wulbert, Nyman, Snow and Owen (1973)

A second group, also mute, are the psychologically disturbed or disabled, largely adult psychotics, who may be considered to have a full repertoire of responses but with whom it is unlikely that the major problem is the correct identification of discriminative stimuli for speech. Studies in this field have been reported by:

Baker (1970)

Baker (1971)

Cliffe (1974a)

Cliffe (1974b)

Hamilton and Stephens (1967)

Hoyer, Kafer, Simpson and Hoyer (1974)

Isaacs, Thomas and Goldiamond (1960)

Isaacs, Thomas and Goldiamond (1965)

Kassorla (1968)

Sherman (1963)

Sherman (1965)

Sherman (1968)

Thomson, Fraser and McDougall (1974)

Wilson and Walters (1966)

Finally, there are some studies with the aim of modifying psychotic speech, e.g.,

Anderson and Alpert (1974)

Ayllon and Haughton (1964)

Bartlett, Ora, Brown and Butler (1971)

Kazdin (1971a)

Liberman, Teigen, Patterson and Baker (1973)

Lindsley (1959)

Lindsley (1963)

Meichenbaum (1969)

Nydegger (1972)

Patterson and Teigen (1973)

Wincze, Leitenberg and Agras (1972)

A.3. Summary

Appendix A provides a brief survey of verbal behaviour from an operant point of view. Comprehensive references are provided for the topics of: experimental control of verbal behaviour; verbal conditioning of basically normal behaviour, with particular reference to the question of awareness; acquisition of speech in non-verbal children; production of functional speech in the dysfluent; verbal behaviour in the classroom; electively mute children; psychotically mute adults; and modification of psychotic speech. Verbal behaviour modified by token reinforcement is discussed in Chapter 2.8.

(Group I)*	Age	Years in Hospital	Diagnosis	Maintenance Medication
B,VS	63	34	Residual Schizophrenic	Thiothixene Procyclidine
B,FJ	57	13	Residual Schizophrenic	Veractil
D,S**	57	9	Chronic Schizophrenic	Chlorpromazine
E,F	60	24	Residual Schizophrenic CVA (1971)	Melleril Anatenzol
F,BT	58	20	Residual Schizophrenic	Melleril
J,GC	62	3	Residual Schizophrenic (Leucotomy)	Melleril
McF, AJ	59	28	Chronic Schizophrenic	Chlorpromazine
McI, DA	49	30	Residual Schizophrenic	Nortriptyline
S,RM	38	11	Mild mental retardation Antisocial personality	Chlorpromazine, Cogentin
Y,S**	55	(Admitted May 1972)	Korsakoff's psychosis	Nil
(Group II)*				
B,P**	50	1.5	Mental Retardation Epilepsy	Phenobarbitone
C,WG	38	23	Chronic Schizophrenic	Stelazine Procyclidine
C,G**	42	4	Epilepsy; Mental retardation	Phenobarbitone, Dilantin

APPENDIX B

PATIENTS' AGE, YEARS OF HOSPITALISATION, DIAGNOSIS AND MAINTENANCE MEDICATION AT 1st JANUARY 1972

Group II, ctd.	Age	Years in Hospital	Diagnosis	Maintenance Medication
D,CV	56	26	Schizophrenic	Haloperidol
H,N	50	20	Paranoid Schizophrenic	Haloperidol, Phenergan
K,CV	56	10	Borderline Mental Retard-ation; Epilepsy	Melleril
O'G, FM	55	22	Residual Schizophrenic	Stelazine, Veractil, Chlorpromazine
T,CR	42	22	Chronic Simple Schizophrenic	Chlorpromazine, Procyclidine, Disipal
W,JH	44	7	Moderate Mental Retardation	Chlorpromazine
(Group III)*				
B,R	41	9	Epilepsy	Folic Acid, Dilantin, Phenobarbitone, Diazepam
B,G	62	32	Residual Schizophrenic	Melleril
C,J	55	34	Chronic Schizophrenic	Stelazine, Haloperidol, Cogentin
E,JAP	56	24	Chronic Schizophrenic	Stelazine, Nortriptyline, Chlorpromazine
H,LMC	51	3	Korsakoff Syndrome	Haloperidol, Cogentin
J,EV	61	28	Simple Schizophrenic Mental Retardation	Nil
M,GW	34	13	Chronic Schizophrenic	Fluphenazine, Cogentin, Veractil
S,JA**	59	3	"Psychosis" Epilepsy	Nil
W,JF	78	4	Involutional paraphrenia	Melleril

(Group IV)*	Age	Years in Hospital	Diagnosis	Maintenance Medication
B,WE	57	34	Residual Schizophrenic	Chlorpromazine
B,P	57	38	Chronic Schizophrenic (leucotomy)	Fluphenazine
E,EF	50	6	Borderline Mental Retardate Sexual Deviant	Fluphenazine
H,W	44	27	Borderline Mental Retardate	Nil
H,A	60	20	Epileptic	Phenobarbitone, Dilantin, Melleril, Cogentin
D,M	35	8	Chronic Schizophrenic	Stelazine, Cogentin
R,W	56	28	Paranoid Schizophrenic	Melleril
W,BG	52	30	Residual Schizophrenic (castrated)	Chlorpromazine, Stelazine, Cogentin
W,A**	57	20	Paranoid Schizophrenic	Thiothixene
("Group V")*				
B,LH	60	12	Schizophrenic	Chlorpromazine
C,W	65	0.5	Korsakoff's Psychosis	Amitriptyline, Digoxin
J,JG	68	22	Paranoid Schizophrenic	Fluphenazine, Cogentin
J,IN	56	35	Residual Schizophrenic Brain damage	Haloperidol
T,AC	64	32	Paranoid Schizophrenic	Chlorpromazine
Y,CA	57	28	Catatonic Schizophrenic	Thiothixene, Cogentin, Tolbutamide
S,B	36	11	Epilepsy, brain damage	Chlorpromazine, Dilantin, Phenobarbitone, Tegretol, Folic Acid.

Appendix B, ctd.

* Patients not in groups for Experiment I or Experiment II.

Data presentation provides ready comparison with Appendices C, D, E and F which contain the raw data on the performance of individuals across the four experiments. "Group V" are patients transferred from ward at the end or during Experiment I including one (S,B) who did not take part in the experiment.

** Patients not living on ward during Experiment I

Experiment I: Patients' Verbal Responses (Raw Data)

(Group I)*	NR1				CR1				NR2				CR2			
B,VS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B,FJ	0	0	0	0	0	0.5	0	0	0	0	0	0	0	0	0	0
D,S	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
E,F	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
F,BT	0	0	0	0	0	0	0	0	2.5	0	0	0	0	0	0	0
J,GC	0	0	0	0	0	3	3	0	0	1.5	1	1	0	0	0	0
McF, AJ	0	0	16.5	10.5	18.5	18	28	29.5	15.5	0	10.5	14.5	35	37	41	39.5
McI,DA	0	1	0	0.5	0	0	0	0	0	0	0	0	0	0	0	0
S,RM	0	0	0	0	0	0	25	22	2	0	0	0	6	0	0	0
Y,S	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
(Group II)*																
B,P	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C,WG	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
C,G	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
D,CV	5	12	19	39.5	14.5	8.5	28	13.5	19	17	21	26.5	28	33	26	35
H,N	0	0	0	0	0	0	0	19.5	22	0	0	28	31.5	22	23	54.5
K,CV	5	0	1	0	4	0	2	0	1	0	2	4.5	3	1	2	5
O'G,FM	11	5	18.5	7.5	1	0	9	7	4.5	10.5	9	8	19	19	14	19
T,CR	1	0	0	18.5	13	17.5	47	14.5	14	30	0	10.5	18.5	33	30	16
W,JH	0	0	0	0	0	1	1	1	1	0.5	3.5	3	4	15	5	4.5

Experiment I: Patients' Verbal Responses (Raw Data), continued

(Group III)*	NR1				CR1				NR2				CR2			
B,R	4	0	1	8.5	1	11.5	0	15	6	13.5	0	3.5	0	25	0	0.5
B,G	0	0	0	0	7	1	3	7	7	0	4.5	0	4	7	1	7.5
C,J	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
E,JAP	1	2	2	0	0	0	0	0	0	1	0	0	0	0	0	0
H,LMC	0	0	0	0	0	0	0	0	2	0.5	0	0	0	0	0	0
J,EV	0	0	0	0	0	0	0	0	0	1.5	0	0	0	0	0	0
M,GW	25	5	18.5	15	20	3	3	26	9.5	7.5	13.5	0	0	39	9	19
S,JA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
W,JF	5	7	1	0	0	0	4	0	0	1	0.5	0.5	0	0	0	0
(Group IV)*																
B,WE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B,P	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
E,EF	0	0	9	0	13.5	7	16	27.5	6	9.5	16	6	4	26	31	27
H,WC	29	0	21.5	29.5	29.5	37.5	0	0	0	23	35.5	27	64.5	49	72	41.5
H,AC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
M,D	1	0	0	2.5	0	0	0	5.5	0	0	2	0	0	5	3	0
R,WA	82	8	24	12.5	14.5	11.5	9	47	4	4	30	13.5	42	4	25	14.5
W,BG	0	3	3	1.5	0	2	3	3	1	2	6.5	9	2	6	9	2
W,A	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Experiment I: Patients' Verbal Responses (Raw Data), continued

("Group V")*	NR1				CR1				NR2				CR2			
B,LH	0	0	1	3	17	15	16	19.5	8.5	0	11	19	8	3	7	1
C,W**	-	-	-	-	-	-	4	3	10.5	14.5	17	9	10	3	15	4
J,JG**	1	1	2.5	0.5	0	0	-	-	-	-	-	-	-	-	-	-
J,IN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
T,AC**	11	7	13.5	15	8.5	5.5	9	16.5	-	-	-	-	-	-	-	-
Y,CA	0	0	0	0	0	1	7	0	0	0	0	0	0	0	0	1.5
S,B	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

NR1 No Reinforcement

NR2 No Reinforcement

CR1 Continuous (Token) Reinforcement

CR2 Continuous (Token) Reinforcement

*Patients not in groups for Experiment I or Experiment II. Data presentation provides ready comparison of performance of individuals across all four experiments. "Group V", are patients transferred from ward at end or during Experiment I, i.e., they do not appear in Experiments II, III or IV.

** Patients not included in analysis of data as not present for duration of experiment. Data also not analysed on patients who made fewer than 3 responses throughout experiment.

- - Not present on ward.

Experiment II: Patients' Verbal Responses (Raw Data)

(Group I)*	NCR1					CR1-I			NCR2			CR2-D		
B,VS	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B,FJ	0	0	0	0	0	10	9	4	0	0	0	13	11	23
D,S	0	0	0	0	0	0	0	0	0	0	0	0	0	0
E,F	0	0	0	0	0	0	0	0	0	0	0	0	0	0
F,BT	0	0	0	10	8	57	70	75	24	32.5	35.5	60	52	82
J,GC	0	11.5	1	21.5	25.3	63	45	50	48.4	45	36.5	59	62	73
McF,AJ	0	5.5	7.3	4.5	9.3	41	50	58	14.6	6.5	5.5	49	50	58
McI,DA	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S,RM	13	7	6.6	7.5	4.3	36	30	31	6.6	2.5	0.5	17	25	22
Y,S	0	0	0	0	0	21	44	49	0	0	0.5	0	35	29
(Group II)*														
B,P	0.3	1.5	7.6	5	14	56	56	56	1.2	1.5	2	0	56	72
C,WG	0	0	0	0	0	0	0	0	0	0	0	0	0	0
C,G	8.3	6.5	9.6	16.5	12.3	55	81	89	0.8	6.5	7	60	71	84
D,CV	37.6	27	48.3	34	27.6	51	48	56	27.4	21	8.5	54	50	0
H,N	0	16.5	18	5	4.3	68	86	93	8.4	13.5	8	71	80	79
K,CV	0	0	0	1.5	1.3	25	20	48	0	0	0	50	51	78
O'G,FM	1.6	3	0	0	0	26	45	51	0	0	1	44	61	62
T,CR	61.3	33.5	4	33.5	28	15	38	49	55	43	3.5	1	29	52
W.JH	1.6	1	1.3	1.5	13	51	38	89	20.4	3	10.5	23	28	84

Experiment II: Patients' Verbal Responses (Raw Data), continued

(Group III)*	NCR1					CR1-I			NCR2			CR2-D		
B,R	0	0	14	5.5	14.3	66	94	93	4	10	54	86	92	81
B,G	0	6	0	0	0	8	5	1	0	0	0	9	0	1
C,J	0	0	0	0	0	0	0	0	0	0	0	0	0	0
E,JAP	0	0	0	0	0	22	10	22	0	0	0	4	12	22
H,LMC	9	14.5	15.3	16.5	27	33	22	65	38.6	33.5	37.5	56	49	75
J,EV	0	0	0	0	0	0	0	0	0	0	0	0	0	0
M,GW	3.6	6	0	8.5	7.3	14	16	17	9.7	15.5	5.5	9	13	42
S,JA	11.6	9.5	43,6	29	37.3	60	89	85	56.8	46	37.5	73	90	85
W.JF	0	0	0	0	0	0	0	0	0	0	0	0	0	0
(Group IV)*														
B,WE	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B,P	0	0	0	0	0	0	0	0	0	0	0	0	0	0
E,EF	4	1	2.3	1	7.6	33	79	75	2.1	2	0	59	48	76
H,WC	14.6	28.5	53	45	47.6	77	71	86	31.4	34.5	37.5	67	66	92
H,AC	0	0	0	0	0	0	0	0	0	0	0	0	0	0
M,D	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R,WA	26	19.5	0	0	30	68	65	85	40.8	37.5	55	75	80	81
W,BG	0	0	0	0	0	1	2	2	0.4	1	0	0	5	0
W,A	0	0	0	0	0	22	29	14	0	1	2.5	25	27	38

Experiment II: Patients' Verbal Responses (Raw Data) continued

NCR1 Non-Contingent Reinforcement

NCR2 Non-Contingent Reinforcement

CR1-I Continuous (Token) Reinforcement - Immediate**

CR2-D Continuous (Token) Reinforcement - Delayed **

*Patients not in groups for Experiment 1 or Experiment 2. Data presentation provides ready comparison of performance of individuals across all four experiments.

Note: Data not analysed on patients who made fewer than 3 responses throughout experiment.

** Data in these two conditions were converted to be equivalent to 100 stimulus questions which were given in the two non-contingent reinforcement conditions.

GROUP I		NCR			CR			CR			CR			NR		
B,VS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B,FJ	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
D,S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
E,F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
F,BT	17	26.5	22.5	27.5	23	25	21	23	19	23	13	24	25	28.5	26	24.5
J,GC	24	17	19.5	10	19	15	24	17	20	23	30	27	19	16	13	7
MCF,AJ	11.5	12.5	13	13.5	19	20	22	19	22	17	26	28	36	27	38.5	28.5
McI,DA	0	0	0	0	2	4	12	10	8	5	7	2	0	0	0	0
S,RM	14.5	16	17	9	11	10	9	18	22	16	21	25	19	15	8	14
Y,S	31.5	38.5	45	20	14	23	25	22	25	14	18	25	34	48	43	57.5
GROUP II		NCR			CR			FR 66%			FR 66%			NR		
B,P	0	2	3	3.5	4	6	9	10	0	0	2	8	1	1	3	0
C,WG	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
C,G	11	14	7	6	8	10	6	6	5	6	7	10	6	5	7	6
D,CV	49	45	35	27	24	22.5	29	34	25.5	32	32	31	34	57	70	62
H,N	8	0	32	35	36.5	43	44	40.5	46	35.5	39	47	33	39	27	29
K,CV	0	0	0	2	0	2	1	1	0	0	3	4	1	2	0	0
O'G,FM	9	17	20	13	9	19	17	17.5	22	11	19	11.5	14	16	10	3
T,CR	40	35	25	12	13	20.5	8.5	12	24	27	22	28	53	30	33	58
W,JB	0	0	0	2	0	1	1	0	1	0	2	3	0	0	1	0
GROUP III		NCR			CR			FR 33%			FR 33%			NR		
B,R	7	5	14	5	0	0	0	0	9	1	3	7	6	1	7	20
B,G	3	0.5	0	1	9	4.5	4	8.5	0	2	0	6	0	7	3.5	0
C,J	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
E,JAP	0	0	0	3	3	1	0	1	0	1	0	3	6.5	5	1	4
H,LMC	41	48	53	28	32	27	33	33	26	32	50	49	50	52	86	70.5
J,EV	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
M,GW	5	0	2	1	11	6	6.5	5	0	0	7	4	6	5	2.5	0
S,JA	29	27.5	30	17	17.5	24	17.5	21	31.5	36	24	24	38	28	25	25.5
W,JF	0	12.5	9	5	9.5	6	6	3	8	7	4	17.5	2	19	16	5
GROUP IV		NCR			CR			FR 66%			FR 33%			NR		
B,WE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B,P	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
E,EF	6	6.5	7	4	13	5	11.5	11.5	14	7	21	11	38	0	5.5	8.5
H,WC	39	35	24	36	26	29	23	31	35	46	42	61	54	68	59	53.5
H,AC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
M,D	0.5	0.5	2	4	0	4	0	5	6	4.5	5	11	9	0	8	0
P,WA	25	20	12	13	13	16	21	17	17	24	23	24	20	23.5	32	18.5
W,BG	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
W,A	19.5	26	10.5	7	12	19	11.5	11.5	21	31.5	20	47	28	46	48.5	44

NCR Non-Contingent Reinforcement FR 66% Fixed Ratio 66% (Token) Reinforcement NR No Reinforcement
CR Continuous (Token) Reinforcement FR 33% Fixed Ratio 33% (Token) Reinforcement
Note: Patients who made no responses throughout experiment excluded from data analyses.

APPENDIX E EXPERIMENT III: PATIENTS' VERBAL RESPONSES (Raw Data)

GROUP I	CR				VR 80%				VR 20%				VR 66%				VR 33%				NCR					
B,VS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B,FJ	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
D,S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
E,F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
F,BT	26.5	31	23	33	29	27	33	20	36	33	33	38	25	-	28	45	45	36	31	22	40	40	35.5	26	42	31
J,GC	24	48.5	37.5	41	37	54	38	31.5	39	47	49	47	43	55	56	49	42	56	41.5	43	41	39	30	51	66	47
McF,AJ	27	32.5	35.5	29	35	47	49	44	48.5	58	52	34	58	66	54	70	47	64	55	68	36	43	39	51	25	28
McI,DA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S,RM	17.5	33.5	45	9	27	57	31	34	16	33	34	26	32	42	27	53	40	37	35	41	27	23	22	44	24	20
Y,S	31.5	45	46.5	54	54	56	41	54.5	52	52	47	35	72	61	73	50	66	64	33.5	65	61	77	63.5	66	87	57
GROUP II	CR				VR 20%				VR 80%				VR 33%				VR 66%				NCR					
B,P	0	0	0	0	3	6	8	6	0	6	11	7	5	0	1	3	0	0	0	0	0	0	0	0	0	0
C,WG	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
C,G	10.5	3	5	13	7	15	11	13	8.5	11	15	12	11	14	13	12	9	17	15	14.5	12	21	22	19	19	9
D,CV	35	40	42	53	35	32	39	33	63	47	70	56	39	32	55	42	52	49	46	49	42	32	32	37	26	34
H,N	33.5	25.5	38	32	50	34	32	9.5	11	28	52	68	45	37	37	72	50	68	65	66	56	60	62	62	47	71
K,CV	0	6	0	3	4	1	0	2	1	2	1	5	0	3	1	1	1	4	0	0	1	2	0	0	2	2
O'G,FM	20.5	22	20	27	31	28	33	22	24	18	40	33	26	34	47	43	30	39	34.5	48.5	15	8	18	24	25	23
T,CR	37.5	49.5	29	47	56	66	58	28	52.5	46	9	33	35	72	70	62	71	67	50.5	72	83	84	63	69	50	62
W,JH	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0
GROUP III	CR				VR 33%				VR 66%				VR 20%				VR 80%				NCR					
B,R	2	20	19	8	0	0	0	0	0	0	0	0	17	17	17	17	2	9	7	6	11.5	0	5	6	6	2
B,G	3	0	2	2	0	0	0	0	0	1	6	1	0	0	0	0	3	0	0	4	0	0	1	0	2	1
C,J	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
E,JAP	1	4.5	8	1	7	2	4	1	14	10	10	9	12	16	17	10	15	19	17.5	16.5	16.5	22	22	16	22	26
H,LMC	52.5	84	72	92	80	85	89	44.5	71.5	54	60	60	65	73	50	55	55	56	44.5	60	37.5	55	22	22	45	45
J,EV	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
M,GW	0	0	8	32	9	16	9	16	17.5	14	8	11	16	35	30	15	18	18	13.5	13.5	15	10	31	13	9	6
S,JA	41	34.5	45	69	57	80	52	51.5	66	58	74	50	42	43	42	76	38	49	60.5	64	57.5	58	61	52	62	60
W,JF	7	4.5	11	0	18	11	0	17	8	11	10	12	6	11	7	19	11	17	13.5	10	13	26	12	18	19	16
GROUP IV	CR				VR 66%				VR 33%				VR 80%				VR 20%				NCR					
B,WE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B,P	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
E,EF	17	19.5	26	24	40	30	27	27	36	27	27	24	25	26	19	33	24	34	15.5	21	8	7	15	10	7	12
H,WC	39	37	63	72	68	59	73	68	54	75	92	85	68	79	74	71	88	63	76	70	70	77	99	99	103	147
H,AC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
M,D	2.5	8	5	5	4	5	6	5	4	4	4	4	4	5	4	5	11	8	6	6	4	8	8	13	9	8
R,WA	15.5	21.5	27	20	29	14	8	24	26	32	40	24	43	36	30	41	39	34	37.5	58	40	48	41	67	52	20
W,BG	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11
W,A	31	23	56	39	57	42	48	9	42	46	16	42	47	44	46	59	66	47	58	60	52	54	99.5	-	-	-

CR Continuous (Token) Reinforcement
VR 80% Variable Ratio 80% (Token) Reinforcement
VR 66% Variable Ratio 66% (Token) Reinforcement
VR 33% Variable Ratio 33% (Token) Reinforcement
VR 20% Variable Ratio 20% (Token) Reinforcement
NCR Non-Contingent Reinforcement

Note: Patients who made no response throughout the experiment were excluded from the data analysis. Also excluded were the responses of one Group IV patient (W,BG) who made a total of 11 responses all in the last few minutes of the final session under non-contingent reinforcement.

APPENDIX F EXPERIMENT IV: PATIENTS' VERBAL RESPONSES (Raw Data)

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